NUCLEAR SCIENCE ABSTRACTS

Volume 29 Number 8

Abstracts 18028-20581

April 30, 1974

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Volume 29, Number 8, April 30, 1974

NUCLEAR SCIENCE ABSTRACTS

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Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts.* The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts,* available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multi-volume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{233}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{233}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

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73-44	28-18601	AT
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8145.3(Vol. 1)	28-20537	Dept. of Conservation, Sacramento, CA $3.00

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 29, Number 8 April 30, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 18844, 19675, 20486, and 20487.

18028 (ORNL-4930) ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1973. Lyon, W. S. (comp. and ed.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 87p. Dep. NTIS $5.45.

Research progress is reported in the following areas: instrumentation and advanced methodology; bio-organic analysis; energy programs; nuclear and physics methods; mass and emission spectrometry; method development and special projects (reactor fuel and materials analyses; environmental and biological analyses; and inorganic preparations). A report is included on service analyses and publications, oral presentations, and patents resulting from the research are listed. (DHM)

18029 MOESSBAUER EFFECT AND ITS APPLICATION TO CHEMISTRY. I. Date, S. K. (Tata Inst. of Fundamental Research, Bombay). Indian J. Chem. Educ.; 1: No. 2, 4-7(Jun 1970).

The process of recoiless emission and resonant absorption of gamma rays in nuclei bound in solids, known as Moessbauer effect, is explained in detail. Application of this effect to analytical studies in chemistry are discussed. The Moessbauer spectrometer used to determine the absorption spectrum of any particular nucleus is described. The most common isotopes used for Moessbauer studies are ^{57}Fe and ^{119}Sn. Based on a study of the Moessbauer spectrum, parameters such as isomer shift (or chemical shift), hyperfine interaction, quadrupole interaction, and resonance effects in a particular nucleus can be evaluated, which in turn reveal the nature of chemical binding or crystal structure of the solid studied. (INIS)

18030 DETERMINATION OF RARE EARTHS IN GEOLOGICAL SAMPLES AND RAW MATERIALS. Haskin, L. A.; Korotev, R. (World Meteorological Organization, Geneva). pp 183-211 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

The relative abundances of the rare earth elements (REE) in rocks and minerals are related to those of the chondritic meteorites, which are believed to have preserved the REE with the same relative abundances as were present in the primitive matter from which the planetary bodies in the solar system developed. The relationships among relative REE abundances in different materials are most easily seen through the use of comparison diagrams with chondritic meteorites or with more immediately related materials. On such diagrams, differences in relative REE abundances between two materials appear, except for Ce and Eu, as smooth functions of REE atomic number. This is a consequence of the type of chemical separations that accompany rock-forming processes. Accurate and sensitive geochemical analysis is now done mostly by neutron activation analysis or mass spectrometric isotope dilution, sometimes on nanogram and subnanogram quantities of the individual REE. Precision for isotope dilution is a fraction of a percent, that for neutron activation ranges from about ±1% to about ±10%, depending on the element. Useful data are also obtained by spark-source mass spectrometry and x-ray fluorescence, with precision ranging upwards from about ±10%. Because all rocks and minerals apparently give smooth curves on comparison diagrams with chondritic meteorites, very accurate concentrations for unanalyzed REE can be obtained by interpolation on comparison diagrams drawn through ratios for carefully analyzed REE. Reasonably good estimates for most of the REE can be obtained from estimated comparison diagrams based on analyses for as few as 4 of the REE. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 18375, 18428, 18478, and 18554.

18031 (CEA-R-4539) DETERMINATION OF TRACES OF LIGHT ELEMENTS IN ALKALI METALS USING γ PHOTON AND CHARGED PARTICLE ACTIVATION. Nordmann, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Jan 1974. 116p. (In French). Dep. NTIS (U.S. Sales Only) $8.00.

Thesis. Submitted to Strasbourg Univ. (France).

The various γ and charged-particle activation methods used to determine light elements are described in a general way. The determination of carbon and oxygen in sodium and cesium using γ photons and the determination of sulfur using protons are then described in greater detail. Several activation curves were determined. They enable the theoretical sensitivities of the methods to be calculated and the interferences due to the principal nuclear side reactions to be evaluated. The effect of the matrix, which is particularly important in the case of sodium, is studied. The calibration methods are described. Special emphasis is given to the possibility of having to use an internal calibration technique for determinations effected using photons. The calibration curves are plotted. In order to render these analytical methods suitable for determining, in a general way, infinitesimal traces of elements, different methods were developed and others improved for radiochemically separating elements from sodium and cesium (^{11}C, ^{15}O, ^{17}F, ^{18}F, and ^{34m}Cl). Some applications of the activation and chemical separation methods developed are given; the results of various different determinations are presented and discussed. Contents of 0.25 μg/g of carbon, 0.3 μg/g of oxygen, and 0.6 μg/g of sulfur were determined in pure sodium. For cesium the relative values obtained were higher, 1 μg/g of carbon and 8 μg/g oxygen. The possibility of eliminating the effects of any contamination and also of dispensing with blanks in this activation analysis enabled extremely low concentrations of these elements to be determined in alkali metals, such determination being made for the first time. (auth)

18032 (CEA-R-4544) MICROANALYSIS BY NUCLEAR REACTIONS AND BY ATOMIC EXCITATION WITH LOW ENERGY CHARGED PARTICLES. Application to Plants Analysis. Oberlin, J. C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jan 1974. 107p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

Microanalysis by nuclear reaction and detection of characteristic x-rays was used to measure the distribution of fluorine, calcium, and potassium along fir needles. Fluorine (destroying element) was analyzed by the ^{19}F(p,α)^{16}O reaction (1350-keV resonance). Simultaneously concentrations of calcium and potassium were measured by means of their characteristic Kα and Kβ x-rays excited by the proton beam. The experimental set up involved a 2-MeV Van de Graaff accelerator, and charged-particle and x-ray detectors [the last is a detector Si(Li), FWHM

200 eV when used with the accelerator]. Distribution of fluorine, calcium, and potassium in the fir needles is shown and some evidence of a relation between the destroying element (fluorine) and the major components of the plant (calcium and potassium) is given. (auth)

18033 (IEA-24) APPLICATION OF ACTIVATION ANALYSIS TO THE SOLUTION OF PROBLEMS IN ARCHAEOLOGY AND ART. Vasconcellos, M. B. A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1973. 20p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.00.

The importance of the application of scientific analysis to the compositional and structural study of artistic and archaeological objects is discussed. Activation analysis is presented as one of the most adequate methods for this kind of study, due to the fact that the available specimens are generally very small and the activation method is highly sensitive. Some compositional studies of several objects of archaeological interest, made of materials such as ceramic, glass, metal (mainly coins), bones, and teeth are also presented, together with the conclusions drawn. A few papers about the study of pigments from paintings by activation analysis are described. In these studies, the concentration of trace elements in white lead, which is the principal component of all the pigments, is determined. Two papers about the structural study of paintings by neutron activation radiography are described. In these papers, some very interesting conclusions about the techniques employed by the painters are drawn. In the case of a painting of the American artist Ralph A. Blakelock, the authors present irrefutable evidence of forgery. Finally, a study of the regeneration of faded photographs by neutron activation radiography is related. (auth)

18034 (KFK-1879) DETERMINATION OF FISSILE MATERIAL IN FUEL RODS BY THE SLOWING DOWN TIME SPECTROMETER. Klunker, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1973. 126p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The slowing down time spectrometer offers the capability for nondestructive measurements of the fissile content in reactor fuel rods. The measurement is based on counting after a neutron burst injection the time dependent fission rate of the fuel rod. The difference in cross section shape allows the separate and simultaneous determination of the ^{235}U and Pu contents. This method was investigated theoretically and experimentally with respect to feasibility and accuracy. Optimum time intervals for the measurement are proposed, analytical expressions with empirical constants are given to correct for resonance self shielding, and different error sources and corrections are discussed. The accuracy obtainable is 2% for a 2-min measuring time. In addition analytical expressions with empirical parameters are given to calculate effective resonance integrals of fuel rods with mixed fuel. (auth)

18035 (UCID-15644-73-3) ANALYTICAL CHEMISTRY QUARTERLY REPORT, JULY–SEPTEMBER 1973. Harrar, J. E. (comp. and ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1973. Contract W-7405-eng-48. 33p. Dep. NTIS $3.75.

The status is reported for various research projects in the analytical Chemistry Division of Lawrence Livermore Laboratory including studies on a system for determining tritium in solid material and simulation language CSSL3 for application to computer studies of nuclear fuel processing. (DHM)

18036 DETERMINATION OF TRACE AMOUNTS IN PURE IRON BY NEUTRON ACTIVATION ANALYSIS. de Wispelaere, C. Ghent; Ghent State Univ. (1973). 155p. (In Dutch).

Thesis.

Trace impurities in pure iron were determined by reactor neutron activation analysis. Three methods for the determination of trace impurities in iron were developed: a nondestructive technique by means of long-lived isotopes, a nondestructive technique by means of short-lived isotopes, and a destructive technique. The destructive technique is mainly based on ion-exchange separations in 1M hydrofluoric acid. (LK)

18037 THORIUM DETERMINATION IN GLASSES USING FISSION TRACK TECHNIQUE. Reimer, G. M.; Carpenter, B. S. (National Bureau of Standards, Washington, DC). Nature (London); 247: No. 5436, 101-102(11 Jan 1974).

In the experimental work described two irradiations were performed, the first with thermal neutrons for determination of the U content, comparing with a standard and knowing the isotopic ratio of U, and the second with fast neutrons to give the combined U and Th contents. The "track excess" in the second irradiation was attributed to the fission. Factors important for the evaluation of a standard are discussed. The fission track results compared well with Th determinations by other methods. The technique can be easily adapted for determination of Th in minerals. (UK)

18038 OSMIUM, RUTHENIUM, IRIDIUM, AND URANIUM IN SILICATES AND CHROMITE FROM THE EASTERN BUSHVELD COMPLEX, SOUTH AFRICA. Gijbels, R. H.; Millard, H. T. Jr.; Desborough, G. A.; Bartel, A. J. (Geological Survey, Denver). Geochim. Cosmochim. Acta; 38: No. 2, 319-337(Feb 1974).

Osmium, ruthenium, iridium, and uranium contents were determined in eight orthopyroxene, seven plagioclase, and three chromite mineral separates from the eastern Bushveld Complex. Neutron activation analysis was used to measure the platinum metals, and uranium was determined by a fission track technique. The platinum metals were found to be present within each mineral in the proportions Os : Ru : Ir = 1 : 7 : 1, while the concentrations of these metals in the minerals are in the ratios orthopyroxene : plagioclase : chromite = 1 : 16 : 700. The concentration of uranium was found to range from 11 to 66 ppB (parts per billion) and not to vary significantly from mineral to mineral. Data for the platinum metals are consistent with a model in which the eastern Bushveld Complex was formed by the fractional crystallization of two separately injected magmas. The existence of two types of chromite was hypothesized; one type with a large distribution coefficient, presumably formed as a cumulus phase at high temperature, and another, more prevalent type with a smaller distribution coefficient, which may have been formed by postcumulus growth at a lower temperature. This hypothesis is supported by data for coexisting chromite-silicate pairs, which indicate that the chromite grains expelled these platinum metals as they cooled. (auth)

18039 DETERMINATION OF BORON AND LITHIUM BY REGISTRATION OF THE PRODUCTS FROM THE (n,α) REACTION. Lobanov, E. M.; Zverev, B. P.; Simakhin, Yu. F.; Usmanova, M. M. (Inst. of Nuclear Physics, Tashkent, USSR). Dokl. Akad. Nauk BSSR; 17: No. 11, 1004-1006(Nov 1973). (In Russian).

A convenient nondestructive method for the determination of B and Li in solids is described. Li is determined by the registration of tritons, formed as a result of the $^{6}Li(n,\alpha)^{3}He$ reaction, with thin scintillation crystals of CsI(Tl) and KI(Tl). The sample-detector system is placed in a vacuum chamber. The B is determined by registration of α particles from the $^{10}B(n,\alpha)^{7}Li$ reaction with an ionization chamber whose construction makes it possible to operate in strong fields of β and γ radiation and fast neutrons from a horizontal reactor channel. The sensitivity of the determination of B and Li is $\sim 5 \times 10^{-5}$ wt%. The results of the determination of B and Li in silicon carbide and in some minerals were reported. (tr-auth)

18040 DETERMINATION OF LEAD IN ATMOSPHERIC AIR AND IN ALUMINUM BY HELIUM-3-INDUCED NUCLEAR REACTIONS. Parsa, B.; Markowitz, S. S. (Univ. of California, Berkeley). Anal. Chem.; 46: No. 2, 186-189(Feb 1974).

Helium-3 activation analysis has been applied to develop a very sensitive means of trace lead analysis. The procedure involves the bombardment of samples with ^{3}He particles to induce a $Pb + {}^{3}He \rightarrow {}^{207}Po$ reaction on lead isotopes. The 992-keV γ-ray of 5.84-hr ^{207}Po is used as the "signal" for lead determination. Only milligram amounts of sample are required. The excitation function for the production of ^{207}Po from the reaction of ^{3}He with lead of natural isotopic composition is presented. If necessary, destructive analysis may be carried out, and a radiochemical separation procedure to plate polonium onto a silver foil is discussed. The accuracy of the measurement is about 3 to 5% for comparative analyses. For absolute determinations, the error is estimated to be 9-12%. Under reasonable irradiation and counting conditions, the detection limit is approximately 50 pg/cm^2, corresponding to 0.5 ppb in a matrix 100 mg/cm^2 thick. (auth)

18041 PLANS FOR ACTIVATION ANALYSIS WITH CHARGED PARTICLES. Petri, H.; Erdtmann, G. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From 4th seminar on activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

Experimental devices for activation analysis utilizing a compact cyclotron are described and the resulting possibilities are discussed. The advantages of this method are based on the high sensitivity in the determination of some light elements (C, N, O, S). In cooperation with the Institute for Solid State Research, the determination of these elements in suprapure materials and crystals are planned. Besides these special studies, the method will also be used for other analytical tasks. (GE)

18042 ACTIVATION OF RAW LIGNITE WITH 14-MeV NEUTRONS. Fahland, J. (Staatliches Materialpruefungsamt Nordrhein-Westfalen, Dortmund, Ger.). (1973). vp. (In German).

From 4th seminar on activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

A nondestructive activation analysis of oxygen using the nuclear reaction $^{16}O(n,p)^{16}N$ and of silicon using the $^{28}Si(n,p)^{28}Al$ reaction in raw lignite is described. The results are compared with those obtained by the usual operational analyses. (GE)

18043 PROBLEMS OF ACTIVATION ANALYSIS WITH CHARGED PARTICLES: DISCUSSED USING THE OXYGEN DETERMINATION IN GaAs AND GaP BY DEUTERON ACTIVATION AS AN EXAMPLE. Martin, J. A.; Fischer, G. (Siemens AG, Erlangen, Ger.). (1973). vp. (In German).

From 4th seminar on activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

Charged-particle activation is much more influenced by error sources compared to the neutron activation. This paper discusses as very important error factors: (1) the implantation of atoms coming from residual gas molecules (O, N, C) of the accelerator tube, (2) the heating of the sample during bombardment, (3) the absolute reliability of the particle-activation analysis as to the comparison with standard materials, and (4) the calculation of decay curves of the β^+-decaying isotopes activated in the sample. (GE)

18044 COMPARISON OF INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS AND ATOMIC ABSORPTION SPECTROPHOTOMETRY FOR ALUMINUM DETERMINATION IN PHOSPHATE MINERALS. Smith, D.; McClain, M. E. Jr. (Georgia Inst. of Tech., Atlanta). Radiochem. Radioanal. Lett.; 16: No. 2, 89-96(14 Jan 1974).

A comparison of Al determination by atomic absorption spectrophotometry and neutron activation analysis has shown that good agreement between these methods exists. NAA determination avoids time-consuming steps required with atomic absorption spectrophotometry. (auth)

18045 DETERMINATION OF IODINE BY NEUTRON ACTIVATION ANALYSIS IN DOPED CRYSTALS OF $CdGa_2S_4$, GaSe, AND GaTe. van Dalen, A.; Wijkstra, J. (Research Reactor Center, Petten, Netherlands). Radiochem. Radioanal. Lett.; 16: No. 2, 97-99(14 Jan 1974).

The iodine content of $CdGa_2S_4$, GaSe, and GaTe crystals was determined by neutron activation analysis using a cadmium-shielded capsule for irradiation. Chemical separation was applied, the chemical yield has been determined with ^{131}I. (auth)

18046 AUTOMATIC SAMPLE EXCHANGER FOR INSTRUMENTAL ACTIVATION ANALYSIS. Bederka, S.; Vandlik, T. (Inst. of Physics, Bratislava). Radiochem. Radioanal. Lett.; 16: No. 2, 81-88(14 Jan 1974).

The construction and characteristics of a quick automatic sample changer in a pneumatic transport tube system are described. (auth)

18047 APPLICATION OF THE BINOMIAL DISTRIBUTION STATISTICS FOR THE ESTIMATION OF THE PRECISION OF ACTIVATION ANALYSIS. Taczanowski, S. (Inst. of Nuclear Techniques, Krakow). Radiochem. Radioanal. Lett.; 16: No. 2, 65-72(14 Jan 1974).

It is pointed out that the statistical component of the total error in activation analysis is in all practical cases subject to the Poisson distribution. (auth)

18048 DETERMINATION OF TRACE ELEMENTS IN NATURAL WATER SAMPLES BY NEUTRON ACTIVATION ANALYSIS. Schneider, J. (Kernforschungszentrum, Karlsruhe, Ger.); Geisler, R. (Technische Univ., Darmstadt, Germany). Z. Anal. Chem.; 267: No. 4, 270-273(Dec 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

The capability of neutron activation analysis as a routine control of drinking water was investigated. Water samples of waterworks in an area of Southern Germany have been analyzed in respect to the content of As, Cd, Cu, Hg, Sb, and Zn. The samples were freeze-dried before irradiation. The disturbing ^{24}Na content has been removed by ion-exchange in the case of Cu, while the other elements have been measured directly. The results are compared with the tentative limits for drinking water suggested by the WHO. The corresponding element concentrations exceeded in two cases significantly these limits. The cost of water analysis by neutron activation is calculated. (GE)

18049 REPORT ON THE FOURTH SEMINAR ON ACTIVATION ANALYSIS. Henkelmann, R. (Univ., Munich). Atomkernenergie; 22: No. 2, 145-146(Oct 1973). (In German).

The seminar on "Special methods of activation" included contributions on activation with photon beams, 14-MeV neutron beams, charged-particle beams, the measurement of prompt gamma radiation, and the use of short-lived nuclides as well as the use of radionuclide sources for irradiations. (GE)

18050 DETERMINATION OF TRACE ELEMENTS IN AIRBORNE DUST SAMPLES BY NEUTRON ACTIVATION ANALYSIS. Vogg, H.; Haertel, R. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Anal. Chem.; 267: No. 4, 257-260(Dec 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

Neutron activation analysis can be applied to the determination of trace elements in airborne dust samples with great advantage, even if the collection time is only a few hours. Cellulose paper filters for collection have proved to contain a particularly small amount of trace elements. Filter efficiencies are satisfactory for most elements. In a short-time irradiation of approximately 1 min in a reactor the elements Se, V, Al, Mg, Br, Cl, In, and Mn can be analyzed quantitatively; in a subsequent long-time irradiation of approximately 1 day, Na, K, Cu, As, W, La, Cd, Au, Sb, Sm, Ca, Fe, Co, Zn, Cr, and Sc can be analyzed quantitatively. Airborne dust concentrations for the elements Se, V, Br, Mn, Cu, As, Zn, Fe, Co were determined at the Karlsruhe Nuclear Research Center and close to the motorway between Karlsruhe and Bruchsal. Increased values close to the motorway were encountered only for bromine. Lead as determined by atomic absorption behaves like bromine. (GE)

18051 EXPERIMENTAL DATA ON PHOTOPEAK INTEGRATION METHODS IN ACTIVATION ANALYSIS. Hertogen, J.; De Donder, J.; Gijbels, R. (Rijksuniversiteit, Ghent). Nucl. Instrum. Methods; 115: No. 1, 197-212(1974).

Experimental data on the performance of various peak integration methods in Ge(Li) gamma-ray spectrometry are presented. Included are the summation methods proposed by Covell, Sterlinski, Quittner, Op de Beeck and Ralston and Wilcox. Another summation technique is based on quadratic background estimation. Special attention is paid to systematic errors due to changing peak-to-background ratios and to instrumental shift. A simplified modification of the Ralston-Wilcox method is proposed and evaluated. (auth)

18052 NON-DESTRUCTIVE MEASUREMENT OF HYDROGEN IN THIN SHEET MATERIALS. Jarvis, O. N.; Sherwood, A. C. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 115: No. 1, 271-275(1974).

The unique features which distinguish a medium energy elastic proton-proton scattering event from other proton-nucleus scattering reactions have been exploited to provide a method of measuring the hydrogen content of diverse materials. The limit to the sensitivity of this non-destructive technique has been shown to be below 10 ppm for a 10-min counting period. (auth)

18053 NEUTRON ACTIVATION ANALYSIS WITH ^{252}Cf. Vogg, H.; Braun, H. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From fourth seminar on activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

An irradiation device, designed for pneumatic tube irradiations and equipped with a ^{252}Cf neutron source, is described. The advantages of its application in activation analysis, particularly for process control, is demonstrated by three examples: (1) determination of fluorine contents of different Teflon samples, (2) analysis of tungsten in Scheelite, and (3) determination of manganese in aerosol samples. (GE)

18054 PROGRAM FOR COMPUTER PROCESSING OF GAMMA SPECTRA MEASURED ON Ge(Li) SEMICONDUCTOR DETECTORS IN NEUTRON-ACTIVATION ANALYSIS OF GEOLOGICAL OBJECTS. Lobanov, E. M.; Levushkin, Yu. A.; Vlasyuga, S. P. (Inst. of Physics, Solids, and Semiconductors, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 9, 805-807(Sep 1973). (In Russian).

Scanning in the spectral region containing photopeaks, calculation of the energy and intensity of the photopeaks, identification of standard isotopes in the spectra, and calculation of the quantitative concentration of elements in the sample are carried out by the program. The processing time for a γ spectrum with a capacity of 3200 channels on the M-220 computer takes 5 to 10 min. (tr-auth)

18055 PLANNED RESEARCH AT THE INSTITUTE FOR RADIOCHEMISTRY ON THE CONTINUOUS DETERMINATION OF HEAVY METALS IN WASTE WATERS USING A ^{252}Cf SOURCE. Specht, S. (Technische Univ., Munich). (1973). vp. (In German).

From 4th seminar activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

First experiences with the use of a Cf-252 source in activation analyses have been applied to the determination of heavy metals in waste waters. The prospects of such a measuring method are discussed and the geometric design of the experimental set-up is described. (GE)

18056 DETERMINATION OF TRACE ELEMENTS IN ATMOSPHERIC AEROSOLS BY MEANS OF NEUTRON ACTIVATION. Clemente, G. F. (CNEN, Rome). Chim. Ind. (Milan); 54: No. 9, 805-808(1972). (In Italian). (RT/PROT-(73)3).

Measurement of the atmospheric trace elements concentration is of great importance in protecting the environment from industrial pollution. In such a general problem, the knowledge of the mineral composition of the particulate matter suspended into the atmosphere is absolutely necessary. Neutron activation analysis is one of the most powerful techniques for measuring quantitatively a large number of the trace elements present in the sample. The instrumental method described gives the Na, K, Sc, Cr, Fe, Co, Zn, As, Br, Rb, Cd, Sb, Cs, La, Ce, Eu, Tb, Au, Hg, and Th concentrations in air filters by avoiding any chemical treatment of the sample. The sensitivity of the method provides the determination of the average trace elements concentration present in 50-m^3 air filter samples. (auth)

18057 DELAYED NEUTRON EMISSION AS A TECHNIQUE FOR THE ASSAY OF FISSILE MATERIAL AT DERE. Bremner, W. B. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). J. Brit. Nucl. Energ Soc.; 13: No. 1, 79-85(Jan 1974).

The delayed emission of neutrons was applied at the Dounreay Experimental Reactor Establishment to the assay of residual fissile material in wastes arising from fuel reprocessing. Two techniques are used depending on the level of gamma radiation associated with the waste. The first deals with waste where the associated gamma radiation level is in the range 7.5 to 750 mR/h. This uses a pneumatically transferred ^{252}Cf sealed source with an output of 1×10^9 neutrons. The second system is used for the analysis of leached fuel element hulls and other wastes where the associated gamma radiation can be up to 1000 Ci. This uses a sealed-tube neutron generator producing up to 3×10^{10} neutrons and is housed in a highly shielded facility. A detection limit of 2 g of fissile material is obtainable on the low-gamma system and 1 g or less on the other, depending on the level of gamma radiation present. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 18242 and 18394.

18058 (AEC-tr-7513) QUANTITATIVE ANALYSIS OF HYDROGEN ISOTOPES BY MASS SPECTROMETRY. Schott, R.; Beau, G. Translated by P. Chastagner from Method. Phys. Anal.; 7: No. 2, 165-169(1971). 14p. Dep. NTIS $3.00.

A method for quantitatively analyzing hydrogen isotopes by mass spectrometry is described. If standardizations are made before and after analysis, a relative precision of 2% is obtained. (LK)

18059 (JAERI-M-5343) HIGH-PURITY URANIUM METAL STANDARD SAMPLE (JAERI-U4) FOR DETERMINATION OF URANIUM. Hashitani, H.; Hoshino, A.; Adachi, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1973. 32p. (In Japanese). NTIS (U. S. Sales Only).

Approximately 8 kg of uranium metal has been prepared as a primary standard for determination of uranium. The high-purity uranium ingot was prepared by fused salt electrolysis and electron-beam melting at the Power Reactor and Nuclear Fuels Development Corporation (PNC) in about 1965. The ingot was pressed and cut into chips ($5 \times 5 \times 2$ mm and 1 g each) without contamination in 1972. The 99.99% purity of uranium was determined by measurement of the 18 impurity elements (total less than 40 ppM) and surface oxide. Direct determinations of uranium by precise gravimetry, coulometry and titrimetry using potassium dichromate as a standard are being studied at present. (auth)

18060 (UCID-15943) CHEMICAL ANALYSIS OF PRESHOT ROCK FROM THE RULISON EXPERIMENT. Hill, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Dec 1971. Contract W-7405-eng-48. 15p. Dep. NTIS $3.00.

Chemical assays of preshot rock samples from the Rulison emplacement hole are reported. (auth)

18061 SPECTROGRAPHIC DETERMINATION OF COPPER, MANGANESE, ZINC, AND MOLYBDENUM IN BLOOD AND OTHER BIOLOGICAL MATERIAL. Granovskii, E. I.; Aksinenko, I. A. Tr. Nauch.-Issled. Inst. Kraev. Patol., Alma-Ata; 22: 245-249(1971). (In Russian).

These metals are determined by excitation of the sample ash in a 10 to 18-amp. a.c. arc. Recommended analytical lines (Å) are Cu I 3453-50 (or Cu 2824-37), Mn I 2801-06, Zn I 3345-02, and Mo I 3170-33. Methods for drying and combustion of the samples (blood, amniotic fluid or placental tissue), the selection of spectrographic base, the preparation of standards, and the selection of an internal standard are described. Examination of 800 samples showed the contents of the cited metals to be very low. (Anal. Abstr.)

18062 ANALYSIS OF ROCKS AND MINERALS BY ATOMIC-ABSORPTION AND FLAME EMISSION SPECTROSCOPY. IV. Composite Scheme for Less-Common Alkali and Alkaline-Earth Elements. Abbey, S. Geol. Surv. Can., Pap.; No. 71-50, 18 (1972).

An analytical scheme is proposed for determining Li, Rb, Cs, Ba, and Sr in the concentrations likely to occur in most silicate rocks. (Anal. Abstr.)

18063 QUANTITATIVE ANALYSIS OF LIGHT ELEMENTS (NITROGEN, CARBON, AND OXYGEN) IN SPUTTERED TANTALUM FILMS BY AUGER ELECTRON SPECTROSCOPY AND SECONDARY ION MASS SPECTROMETRY (SIMS). Morabito, J. M. (Bell Telephone Labs. Inc., Allentown, PA). Anal. Chem.; 46: No. 2, 189-196(Feb 1974).

The quantitative analysis of light elements (N, C, O) in sputtered tantalum films by Auger electron spectroscopy and secondary ion mass spectrometry (SIMS) via calibration with standards and electron microprobe analysis is described. The calibration standards were prepared by reactive sputtering, and the homogeneous distribution of the dopants (N, C, O) in these standards was established by SIMS and Auger in-depth profiling measurements. Although the electron microprobe could reproducibly detect the presence of low levels (< 5 at.%) of N, C, and O, the accuracy of quantitative electron microprobe measurements for these light elements in tantalum below ~5 at.% was questionable due to the lack of sufficiently accurate x-ray absorption coefficients. The accuracy of electron microprobe quantitative results above ~5 at.%, however, was estimated to be within ±10%. The analysis of nitrogen, carbon, and oxygen below ~5 at.% was accomplished by an extrapolation of the normalized Auger and SIMS data. SIMS detection limits for oxygen and carbon were in the ppM range and for nitrogen in the 0.1 at.% range depending on instrument background and amount of sample consumed. The Auger detection limits for N, C, and O were in the 0.3-0.4 at.% range. (auth)

18064 REACTIONS IN THE SYSTEM $[Mo(CN)_8]^{3-}$-Hg STUDIED POLAROGRAPHICALLY. Jarzyna, T.; Stasicka, Z.; Senkowski, T. [Jagiellonian Univ., Krakow]. Rocz. Chem.; 47: No. 10, 1801-1807(1973).

The polarographic behavior of octacyanomolybdate(V) solutions and the oxidation-reduction processes in the system $[Mo(CN)_8]^{3-}$-Hg are discussed. The polarographic method was found useful for quantitative determination of $[Mo(CN)_8]^{3-}$. (auth)

18065 SIMULTANEOUS POLAROGRAPHIC DETERMINATION OF COPPER AND MOLYBDENUM IN MANGANESE-MOLYBDENUM STEELS. Allan, A. L.; Agullo, E.; de la Fuente, B. (Univ. Nacional del Sur, Bahia Blanca, Argentina). An. Quim.; 69: No. 4, 433-437(1973). (In Spanish).

The sample is treated with aqua regia and heated to remove HNO_3, and then H_2O (10 ml) and HCl (15 ml) are added. The solution is extracted with isopropyl ether (25, 10, 10, and 10 ml) to remove Fe and the aqueous phase is concentrated to 1 ml. To this solution is added 12.5 ml of supporting electrolyte [M-Na acetate-M-acetic acid-0.1 M-N'-(2-hydroxyethyl)ethylenediamine-NNN'-triacetic acid] and the pH is adjusted to 4.6. The mixture is diluted to 25 ml and de-aerated in a stream of N, and the polarogram is recorded between 0 and -1.3 V vs. the S. C. E.; no max. suppressor is necessary. The diffusion currents corresponding to Cu and Mo are measured and the concentration of the metals is determined from calibration graphs. The relative error is 1.85% for Mo and 0.75% for Cu. (Anal. Abstr.)

18066 DETERMINATION OF ^{55}Fe IN AIR FILTER AND DEPOSITION SAMPLES BY X-RAY SPECTROMETRY. Winkler, R. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Nuremberg). Z. Anal. Chem.; 267: No. 4, 261-266(Dec 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

Iron-55 was determined in monthly collected air filter and deposition samples at Neuherberg near Munich since March 1970 and January 1971, respectively. After ashing, iron was separated by extraction with di-isopropyl ether. Interfering fallout radio-

nuclides were removed by an ion-exchange step. Finally, iron was electrodeposited on a copper disk and the x-ray spectrum was measured using a proportional counter or a Si(Li) detector. Average activity concentration in the air at Neuherberg was found to be 1.0 fCi per m^3 in 1970 (since March), 1.2 fCi per m^3 in 1971, and 0.36 fCi per m^3 in 1972. The annual deposition to the ground was 697 pCi per m^2 and year in 1971 and 178 pCi per m^2 and year in 1972. (GE)

18067 DETERMINATION OF IODINE IN MARINE ALGAE. Dave, H. M.; Naiya, S. K.; Sharma, N. N.; Seshadri, K. (Central Salt and Marine Research Inst., Bhavnagar, India). J. Indian Chem. Soc.; 50: No. 3, 221-222(Mar 1973).

A technique was developed for the quick fixation and rapid analysis of iodine in seaweed. The method consists of digesting the seaweed with 10% potassium hydroxide in a domestic model pressure cooker for 10 min. The cooled material is dried and ashed at 500°C. The ash is extracted with hot water and iodine is determined iodometrically. The technique is applicable to all the types of the seaweeds. (auth)

18068 DETERMINATION OF IODINE BY ATOMIC ABSORPTION EMISSION SPECTROMETRY WITH A CATHODE SPUTTERING CELL. Kirkbright, G. F.; West, T. S.; Wilson, P. J. (Imperial Coll. of Science and Tech., London). Anal. Chim. Acta; 68: No. 2, 462-465(Feb 1974).

It is shown that the inert gas-filled cathode sputtering cell is useful as an atomizing cell for the direct determination of iodine as iodide by both atomic absorption and emission at the 183.0-nm line. (DLC)

18069 MOLECULAR EMISSION CAVITY ANALYSIS: A NEW FLAME ANALYTICAL TECHNIQUE. II. The Determination of Selenium and Tellurium. Belcher, R.; Kouimtzis, T.; Townshend, A. (Univ. of Birmingham, Eng.). Anal. Chim. Acta; 68: No. 2, 297-304(Feb 1974).

The determination of 0.4 to 4 μg of selenium by molecular emission cavity analysis is described. Selenium in organic compounds is determined after oxygen flask combustion. Metal ion interferences are eliminated by reduction of selenium to the element, filtration onto a glass-fiber paper, and direct incorporation of the filter into the cavity. Applications to the determination of selenium in inorganic and organic compounds are described. The determination of μg-amounts of tellurium is also outlined. (auth)

18070 CHEMILUMINESCENCE IN ANALYTICAL CHEMISTRY. Isacsson, U.; Wettermark, G. (Royal Inst. of Tech., Stockholm). Anal. Chim. Acta; 68: No. 2, 339-362(Feb 1974).

Analytical applications based on chemiluminescence are reviewed. Analyses in the gas phase for atmospheric pollutants such as sulphur compounds, ozone, and oxides of nitrogen are described. The commonest chemiluminescent systems used in the liquid phase are then discussed. Their applications as indicators in different types of titration are outlined. Determinations of organic and inorganic substances are classified according to their action as oxidant, catalyst, or inhibitor. Special applications are described in fields such as forensic science, microbiology, polymer technology, radiation chemistry and flow mechanics. (7 tables, 8 figures, 133 references) (auth)

18071 TRACE ELEMENTS CHARACTERIZATION IN Y_2O_3 BY MASS SPECTROSCOPY AND ISOTOPIC DILUTION. Haaland, J.; Stijfhoorn, D. E. (Institutt for Atomenergi, Kjeller, Norway). pp 154-164 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

Rare earth elements at concentrations down to 0.1 ppM have been determined in pure yttrium oxides using isotopic dilution and the ATLAS CH_4 single focusing instrument with a double rhenium filament ion source. The eight polyisotopic elements were determined in one run after addition of a master-spike. Oxide peaks from the lighter elements were removed effectively by passing benzene through the source. The AEI MS 702 double focusing spark source mass spectrometer with photographic registration was used to give a general survey of the distribution of both RE and non-RE elements. The Y_2O_3 samples were mixed with 60% pure graphite to make them conducting and pressed into a pair of tiny electrodes. A series of spike isotopes were again mixed in for calibration. A simplified plate calibration procedure was used. The peaks of the spike isotopes served for quantitative determinations, either by isotopic dilution or by precalculated sensitivity factors for other elements. A background spectrum from carbon, yttrium carbide, etc. interferes in some cases with analysis lines. The general limit of determination is also in this case 0.1 ppM. (auth)

18072 DETERMINATION OF MICROQUANTITIES OF ^{137}Cs IN LIQUIDS. Nagy, J. (Kossuth Lajos Tudomanyegyetem, Izotoplaboratoriuma, Debrecen, Hungary). Izotoptechnika; 16: No. 12, 674-678(Dec 1973). (In Hungarian).

Method is described for the determination of 3 to 6 pCi/l activity ^{137}Cs in liquids with pH lower than 7 in natural waters, in 15 minutes without activity measurement. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 18334, 18430, 18432, 18771, 18772, and 20490.

18073 (CEA-R-4494) APPLICATION OF SUBSTOICHIOMETRIC SOLVENT EXTRACTION AND LIQUID SCINTILLATION DETECTION TO THE AUTOMATIC ANALYSIS OF ^{95}Zr IN A FISSION PRODUCT SOLUTION. Roux, L. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Dec 1973. 59p. (In French). Dep. NTIS (U.S. Sales Only) $5.00.

A method for automatic determination of ^{95}Zr in fission product solutions was developed from studies of the substoichiometric extraction of this element using a solution of cupferron in toluene and liquid scintillation detection. (auth)

18074 (IEA-288) NONDESTRUCTIVE DETERMINATION OF URANIUM IN LOW-GRADE ORES BY GAMMA SPECTROMETRY: INDIRECT MEASUREMENT BY MEANS OF THE ^{234}Th PHOTOPEAK. Matsuda, H. T.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1973. 21p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.25.

A nondestructive method for uranium determination in low-grade ores by gamma spectrometry is outlined. The method was applied especially to the Morro do Agostinho ore, Pocos de Caldas plateau, Minas Gerais. Uranium determination by this method is based on the measurement of the ^{234}Th (93-keV) photopeak. It is a simple method because a single gamma analyzer can be used. The spectrometer can be installed in the ore treatment plant, making the control work for uranium easier. Radiometric determination is rapid and gives good results, with errors lower than 10%. It can be applied to any uraniferous ore, requirements being the secular equilibrium and content of thorium not higher than 0.25% ThO_2. (auth)

18075 (KURRI-TR-114) DETERMINATION OF FISSION PRODUCTS EMITTED FROM THE SURFACE OF 93% ENRICHED URANIUM-ALUMINUM ALLOYS. Tamai, T.; Hashimoto, T.; Kawamoto, H.; Sagane, T.; Kanda, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1972. 13p. (In Japanese). Dep. NTIS (U.S. Sales Only) $3.00.

The amounts of fission products emitted from 93% enriched U-Al alloys or natural U-metal during neutron irradiation were determined by γ spectrometry using a high-resolution Ge(Li) detector. An Al-collector method and a charcoal trapping method were used for the determination of fission products emitted from uranium samples. The following fission products were detected in the Al collector, ^{133}Xe, ^{135}Xe, ^{131}I, ^{132}I, ^{133}I, ^{99m}Tc, ^{91m}Y, ^{97}Zr, ^{97}Nb, ^{132}Te and ^{143}Ce. The radioactivities of these fission products were estimated in the order of 10^{-16} Ci/cm^2·n. Fission products in unit weight from U-Al alloys were evaluated to be about 2.5 times less than those from U metal. Also studied were the uranium atoms knocked out into the Al collector by fission fragments and the fission fragments captured in the wall of the quartz vessel. (auth)

18076 (SZS-149, pp 17-28) RADIOCHEMICAL DETERMINATION OF STRONTIUM-90 IN SAMPLES OF ENVIRONMENTAL AND PERSONAL MONITORING. Rehak, W.; Feddersen, B. Mar 1973. (In German).

The method for determination of ^{90}Sr using extraction of the daughter ^{90}Y with di(2-ethylhexyl)phosphoric acid (HDEHP) is described. In addition to a general procedure for the ^{90}Sr determination in water, waste water, fallout, filters, plants, meats, and bones, variations for total diet, urine, and soil, and a rapid method for water and waste water are presented. Formulas and tables for evaluation of the results are given. (auth)

18077 STRIPPING THIN LAYERS FROM CHROMATOGRAPHIC PLATES FOR RADIOTRACER MEASUREMENTS. Redgwell, R. J.; Turner, N. A.; Bieleski, R. L. (DSIR, Auckland, N. Z.). J. Chromatogr.; 88: No. 1, 25-31(9 Jan 1974).

A method for stripping cellulose or cellulose-silica thin layers from glass chromatographic plates is described. A cellulose acetate mixture is used after chromatography to bind the particles into a porous, coherent film that detaches itself from the glass spontaneously and cleanly without the use of water. The intact layer can be stored, or the chromatographically separated spots can be cut out on the plate and recovered individually. The nature of the film and the stripping process make the method particularly suitable for radiotracer studies. Water-soluble and

chloroform-soluble compounds can be studied, and radioactivity of ^{32}P, ^{14}C, ^{35}S or ^{3}H can each be measured in the bound layer by scintillation counting without significant quenching or loss of counting efficiency. Water-soluble compounds, and ninhydrin reaction products, can also be eluted from the intact piece of layer for other studies. Details of the procedures used are given and the potential sources of error are discussed. (auth)

18078 POSSIBILITIES OF DETERMINING ELEMENTARY SULPHUR USING X-RAY FLUORESCENCE. Dziunikowski, B. (Inst. of Nuclear Techniques, Krakow). Radiochem. Radioanal. Lett.; 16: No. 2, 73-80(14 Jan 1974).

Rapid determination of the elemental sulfur content in material also containing sulfur compounds using x-ray fluorescence is described. The suggested method can be used when the analyzed material contains no more than two interfering sulfur compounds. (auth)

18079 DETERMINATION OF ^{131}I IN REACTOR DUST PARTICLES COLLECTED ON SILVER FILTERS. Bate, L. C.; Dyer, F. F. (Oak Ridge National Lab., TN). Radiochem. Radioanal. Lett.; 16: No. 2, 59-64(14 Jan 1974).

Iodine-131 collected on Ag filters and graphite dust was determined by a radiochemical method that separates the ^{131}I from the large quantities of ^{110m}Ag and fission products. The sample is dissolved in HNO_3, $HClO_4$, and $NaVO_3$, metathasized to free ^{131}I from Ag which is removed as the metal, and the ^{131}I reprecipitated as AgI. Decontamination factors of 10^3 or greater are obtained with a chemical yield approaching 90%. (auth)

18080 ION EXCHANGE DETERMINATION OF STRONTIUM-89 AND STRONTIUM-90 IN MILK: COLLABORATIVE STUDY. Baratta, E. J. (Northeastern Radiological Health Lab., Winchester, MA). J. Ass. Offic. Anal. Chem.; 57: No. 1, 37-38(Jan 1974).

Eleven collaborators performed a second collaborative study of an ion exchange method for determining ^{89}Si and ^{90}Si. For milk containing 29.0 and 197 pCi/l of ^{89}Sr, the results at 2 levels were: average 31.0, 199.6; range 26-36, 164-290; standard deviation 2.9, 7.2; and percent error 10.0, 3.4. For milk containing 32.4 and 151.2 pCi/l of ^{90}Sr, the results were: average 32.5, 149.9; range 27.2-38.0, 125.3-170.3, standard deviation 0.32, 4.17; and percent error 0.9, 2.8. The method has been adopted as official first action. (auth)

18081 NEW METHOD OF RAPID ANALYSIS OF THREE-COMPONENT SYSTEMS. Bychvarov, N.; Karamanova, Zh. (Inst. of Physics, Sofia). Isotopenpraxis; 9: No. 3, 109-111 (Mar 1973). (In Russian).

A method based on the analysis of backscattered β particles for the rapid analysis of three-component systems is proposed. The method can be used for the qualitative analysis of ores and enriched materials. The time for analysis of one sample is 10 to 15 min. The instrument constructed for the analysis is portable and is simple to operate. The instrument is safe with respect to radiation. (JSR)

18082 MODIFICATION OF CHROMATOGRAPHIC ESTIMATION OF LABELLED IODINATED COMPOUNDS IN SERUM. Bednar, J.; Soutorova, M. (Inst. of Endocrinology, Prague). Endocrinol. Exp.; 6: No. 4, 203-212(1973).

Serum (0.5 ml) containing iodinated amino-acids was added to a column (2.5 cm × 0.7 mm) of Dowex 50W-X2 (H^+ form). The inorganic iodides and the iodoproteins were washed through the column with H_2O (5 ml) and the iodinated amino-acids were eluted with 5N-aq. NH_3 (2 ml) and H_2O (3.5 ml). The eluate fractions were measured for radioactivity, then combined and evaporated to dryness at 70°C under reduced pressure. The acids were then separated by t.l.c. on cellulose, with acetone-0.5N-acetic acid (1:4) as developing solvent. Spots were detected colorimetrically (Gmelin and Virtanen, Analyt. Abstr., 1960, 7, 1863) and by autoradiography, and the radioactivity of the spot material, after transfer into glass phials, was measured with the aid of liquid scintillators. Good separation of the individual compounds and high reproducibility were achieved. Separation of the dried residue from the Dowex column on paper resulted in considerable degradation and deiodination of the acids. (Anal. Abstr.)

18083 EXTENDED APPLICATIONS AND IMPROVEMENT OF THE $4\pi\beta$-γ COINCIDENCE METHOD IN THE STANDARDIZATION OF RADIONUCLIDES. Kawada, Y. (Electrotechnical Lab., Tokyo). Denshi Gijutsu Sogo Kenkyusho Kenkyu Hokoku; No. 730, 1-100(Jul 1972). (In Japanese).

The principle and general nature of the $4\pi\beta$-γ coincidence method and a detailed interpretation of correction are reviewed. A new technique is presented, which combines the $4\pi\beta$-γ and the $2\pi\beta$-γ coincidence countings and offers significant improvement in counting statistics in addition to the considerable reduction of error due to spurious pulses, noise, radioactive contaminants and background fluctuation. The response of the $4\pi\beta$-counter to low energy internal conversion electrons is reported. Several possible causes of systematic error in measuring complex decaying nuclides by coincidence absorption method are discussed. In an attempt to overcome complexity in procedures in the $4\pi\beta$-γ coincidence absorption method, a novel method was developed by using a $4\pi\beta$-γ anticoincidence set-up with a Ge(Li) detector which is described. (JA)

18084 DOUBLE RADIO-ISOTOPE DERIVATIVE TECHNIQUE FOR THE ASSAY OF DRUGS IN BIOLOGICAL MATERIAL. I. The Determination of Maprotiline. Riess, W. (CIBA-GEIBY AG, Basel). Anal. Chim. Acta; 68: No. 2, 363-376(Feb 1974).

The double radioisotope technique is described in general, and a sensitive and specific method is presented for the assay of maprotiline (Ciba 34 276-Ba, Ludiomil) in biological materials. The procedure involves the addition of a definite amount of ^{14}C-labelled maprotiline as internal standard, extraction of the free base, and acetylation with ^{3}H-labelled acetic anhydride. The ^{3}H-labelled N-acetyl derivative of maprotiline is then separated by two-dimensional thin-layer chromatography from ^{3}H-active by-products which arise from reagents and biogenic material. Both ^{3}H- and ^{14}C-activities of the purified acetyl derivative are determined simultaneously by liquid scintillation counting. The yield of ^{14}C-activity makes it possible to evaluate the theoretical 100% ^{3}H-activity of the derivative. A convenient method is described to determine the specific ^{3}H-activity of the N-acetyl derivative. (5 tables) (auth)

18085 METODY PRIGOTOVLENIYA PREPARATOV I OBRABOTKA REZUL'TATOV IZMERENII RADIOAKTIVNOSTI. (Methods For Preparation of Samples and Processing of Data From Radioactivity Measurements). Korobkov, V. I.; Luk'yanov, V. B. Moscow; Atomizdat (1973). 216p.

Development of methods for the preparation of samples for the relative and absolute measurement of the radioactivity were systematized. Preparation of thin backings for preparations, particularly thin organic films, were discussed. Mathematical statistical methods for processing the radioactivity measurements were reported. (tr-auth)

18086 TRACE LEVEL RARE EARTH DETERMINATION BY X-RAY EXCITED OPTICAL FLUORESCENCE SPECTROSCOPY. Fassel, V. A.; DeKalb, E. L.; D'Silva, A. P. (Ames Lab., IA). pp 109-122 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

X-ray excited optical fluorescence (XEOF) has emerged during the past decade as a remarkably sensitive technique for the detection and quantitative determination of rare-earth impurities in a variety of matrices. Although not all aspects of the excitation phenomena are understood, the basic mechanism apparently involves the generation of secondary excitants by the incident x-ray quanta, followed by the highly selective transfer of the energy residing in the excitants to rare-earth ion impurities. Although some metallic oxides serve as analytically useful hosts, it is often necessary to convert the sample into a chemically different, but effective, host system. Ternary and quaternary oxide systems and some phosphates provide detectability of rare-earth impurities in the 1 in 10^3 concentration range. The classical internal reference (standard) principle effectively compensates for the enhancement and depression effects on the fluorescent intensities induced by changing concentrations of other residual impurities in the sample. To date, activated fluorescence of trace rare-earth impurities has been verified in hosts prepared from 55 elements in the periodic system. These observations portend an increasing use of XEOF as a general analytical technique for the ultratrace determination of the rare-earth elements. A selected number of applications of XEOF to the determination of residual rare earth impurities in fertile nuclear materials and in highly purified rare-earth compounds will be discussed. (auth)

18087 X-RAY FLUORESCENCE ANALYSIS OF RARE EARTH ELEMENTS. Bonnevie-Svendsen, M.; Follo, A. (Institutt For Atomenergi, Kjeller, Norway). pp 87-107 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

X-ray fluorescence analysis is used for the direct determination of rare earth elements in rock samples, minerals, rare earth concentrates, products, and process solutions. Only a minimum of sample pretreatment is required. Solid samples are mostly powdered and measured as briquets. Liquid samples can be measured as received, but for larger series of process samples a filter technique is preferred. The x-ray spectra are much simpler than optical spectra, and experience shows that essentially interference-free first or second order lines can be found for most

rare-earth elements in practically all types of rare-earth mixtures. X-ray fluorescence is a rapid and precise method, but careful precautions are required to avoid errors caused by general or selective absorption-enhancement effects. There is a variety of modes to correct for these effects. The use of internal standards, calibration curves, spike and dilution methods as well as cross-checking with other methods is discussed and illustrated by examples. (auth)

18088 EMISSION SPECTROSCOPY FOR RARE EARTH ANALYSES, AND FOR THE DETERMINATION OF IMPURITIES IN RARE EARTH MATERIALS. DeKalb, E. L. (Ames Lab., IA). pp 61-70 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

Emission spectroscopy is the primary and most powerful analytical tool for the chemical analysis of rare earth materials, and for the determination of rare earth impurities in other materials. However, many rare earth elements have a complex emission spectrum, so that spectral equipment and analytical procedures must be selected with care. Rare earth analyses can be classified into four broad categories: - the determination of rare earths in a "pure" rare earth; the determination of other impurities in a rare earth; the determination of rare earths in a mixture of various rare earths; and the determination of rare earth impurities in other materials. Each of these four types of analysis presents the spectroscopist with unique problems which may be solved in several ways. The present state-of-the-art, as measured by detection limits, is reviewed for the first two categories. (auth)

Separation Procedures

Refer also to abstracts 18134, 18213, and 19786.

18089 (BARC-720) EXCHANGE OF METAL IONS AGAINST H^+ OF A CARBOXYLIC ACID EXCHANGER. Ganapathy Iyer, S.; Padmanabhan, P. K.; Venkateswarlu, C. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. Dep. NTIS (U.S. Sales Only) $3.00.

Exchange of several cations from aqueous acidic solutions with a weak cation exchanger, Zeo-karb 226 in H^+ form, is reported. UO_2^{+2}, Bi^{+3}, ZrO^{+2} and Th^{+4} exhibit high K_d values even at pH 2.0, which is in sharp contrast with the view that carboxylic acid type exchangers have unusually high affinity towards H^+. The affinity of this exchanger towards ions like Cu^{+2} and Al^{+3} above pH 4.0 is comparable to that towards H^+. Further work is in progress to extend the study to other cations, to the influence of water-miscible organic solvents, and to elucidate the nature of binding in the exchanger. (auth)

18090 (GERHTR-60) AKUT: A PROCESS FOR SEPARATING AEROSOLS, KRYPTON, AND TRITIUM FROM THE COMBUSTION WASTE GASES IN THE REPROCESSING OF HIGH TEMPERATURE FUEL ELEMENTS. Laser, M.; Beaujean, H.; Vygen, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1973. 6p. Dep. NTIS $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

In the AKUT method the aerosols are separated by electric and absolute filters. The waste gas is then burned with measured quantities of oxygen before it is liquified at 65-70 atm. This liquefied waste gas is fed into a rectification column, and a krypton-rich fraction containing 10-20% by volume of krypton is drawn off at the top of the column. Tritium and iodine are then adsorbed on suitable materials. (LK)

18091 STUDY OF CONDITIONS FOR FORMATION AND EXTRACTION OF THE PYROGALLOL–ANILINE COMPLEX OF URANIUM(VI). Verdizade, A. A.; Ali-Zade, T. D.; Yusifova, G. N. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk; No. 1, 18-22(1972). (In Russian).

In weakly acid medium, a complex that contains U^{VI}, pyrogallol and aniline in the ratio 1:2:2, and that is extractable by organic solvents, is formed. The extent of extraction is greatest from a medium of pH 4·6 to 5·3 with CCl_4 as extractant, and the ϵ value for the complex is 3000. For the determination of U, to 2 ml of solution containing 2·5 to 250 μg of U are added 2 ml of 4% pyrogallol solution, 2 ml of aniline, and H_2O to give 10 ml. The complex is extracted with 6 ml of CCl_4, and the extinction of the extract is measured (blue filter). (Referativnyi Zh.)

18092 POSSIBILITY OF THE APPLICATION OF ION EXCHANGE RESINS PRODUCED IN POLAND TO THE REMOVAL OF RADIOACTIVE CONTAMINATION FROM MILK. Poznanski, S.; Kornacki, K.; Chojnowski, W.; Jedrychowski, L. (Coll. of Agriculture, Olsztyn, Poland). Med. Wet. (Poland); 28: 737-740(1972). (In Polish).

The usefulness of ion exchangers produced in Poland for the removal of the radioactive isotopes of Sr, Cs, and I from milk was estimated. It was stated that the most useful resin to remove radioactive Sr proved to be cationite SD, and for Cs and ^{131}I, cationite MK-3 and anionite LF, respectively. By the use of the above exchangers it was possible to remove about 90.0% of radioactive contaminations from 30 rbv of milk in the case of Sr and Cs, and from 160 rbv of milk in the case of ^{131}I. By the use of the above ionites the basic composition, organoleptic, and physicochemical properties of milk were not changed. The temperature and the rapidity of the column flow influenced significantly not only the removal of radioactive contamination from milk but also the rate of resin regeneration. The effective removal of radioactive Sr from milk was possible at pH = 5.4. The exchangers under study revealed, for removal of radioactive contamination from milk, the same value as Amberlite IR-120 and Dowex 2 × 8 commonly used for the same purposes in the Western Europe. (Nucl. Sci. Abstr. Pol.)

18093 EXTRACTION OF METAL CATIONS FROM AQUEOUS SOLUTIONS BY FROTH FLOTATION. Pustovalov, N. N.; Pushkarev, V. V. (Ural Polytechnic Inst., Sverdlovsk, USSR). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 8, 1815-1818(Aug 1973).

Translated from Zh. Prikl. Khim.; 46: No. 8, 1707-1711(Aug 1973).

In extraction of surfactants from aqueous solutions by froth flotation, ions and colloids were extracted into the froth fraction along with the surfactants. The experiments on froth flotation were carried out by the technique described earlier. Very common agents, sodium alkylsulfates, were used as the surfactants for ion extraction. Two mechanisms of cation extraction from solutions may be postulated: (1) the cations form definite compounds with the surfactant molecules; (2) the cations do not form compounds with the surfactant molecules. (auth)

18094 ANION EXCHANGE CONCENTRATION OF RARE EARTH IMPURITIES IN RARE EARTH MATERIALS FOR ANALYTICAL PURPOSES. Molnar, F. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 55-59 of Analysis and Application of Rare Earth Materials. Mickelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

For a total analysis of rare earth impurities in very pure rare earth matrix elements it is necessary to concentrate these impurities before their analysis. An anion exchange method, based on the chromatographic separation of the impurities and the matrix element using aqueous methanol solutions of ammonium nitrate as eluents, was developed. From the cerium subgroup matrices all rare earth impurities, except the heavier adjacent one, and from the yttrium subgroup matrices only cerium subgroup impurities (and, depending on the atomic number of the matrix element, terbium and dysprosium) can be separated. The enrichment factor for this concentration procedure is about 10^6. The concentrated impurities can be processed further as required by the method for their analytical determination. (auth)

18095 ELECTROCHEMICAL SEPARATION OF TUNGSTEN–MOLYBDENUM ALLOYS. Zueva, A. F.; Styrkas, A. D.; Tarakanov, B. M. (Inst. of New Chemical Problems, Moscow). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 7, 1729-1731(Jul 1973).

Translated from Zh Prikl. Khim.; 46: No. 7, 1621-1623(Jul 1973).

A study was made of the electrochemical dissolution of large lumps of waste W–Mo alloys in HNO_3 and HCl solutions in order to optimize conditions for oxidation and separation. The electrolyzer consists of two glass cells divided by a porous filter; the vessel has a perforated bottom for passage of the oxidation products. Anodic dissolution in HCl was found to result in a high degree of separation (1.5 to 3% Mo in WO_3; 0.5% W in molybdic acid solution). (DLC)

18096 DETERMINATION OF RARE EARTH IMPURITIES IN PURE RARE EARTHS BY MEANS OF EXTRACTION CHROMATOGRAPHY. Herrmann, E. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 39-53 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

Determination of rare earth impurities in very pure rare earth materials is frequently difficult without a preconcentration of the tracers. The use of extraction chromatography with undiluted di(2-ethylhexyl)phosphoric acid (HDEHP) as a stationary phase for the concentration of tracers with lower atomic number relative to that of the macro element has been investigated. Enrichment factors of about 10^6 and yields of more than 80% were obtained with excellent reproducibility when $A_{macro}/D_{micro} \geq 1.5$. D_{micro} is the partition coefficient of the trace impurity, A_{macro} is the position of the front, normalized to the unit HDEHP-volume on

the column, and depends on the loading B (expressed in %) of the column with rare earth ions and on the partition coefficient E of the macro element measured in trace concentration. This dependence can be expressed by the empirical equation: $1gA = 1gE - 0.036B - 0.15$. The influence of macro amounts of a given rare earth element on the partition behavior of other lanthanides present in trace concentrations has also been investigated. The amount of an individual rare earth in the concentrate was determined by optical spectrometry, neutron activation analysis, spectrophotometry with arsenazo III, or complexometric titration with DTPA. In the last two cases it is necessary to use a preliminary separation of the components in the concentrate. This was done either by the cation exchange–α-hydroxyisobutyrate method or by means of extraction chromatography using a HDEHP microcolumn. The standard deviation of the determinations depends only on the analytical procedure, the preconcentration being of negligible importance in this respect. (auth)

18097 TECHNIQUES FOR THE MUTUAL SEPARATION OF THE LANTHANIDES IN ANALYTICAL CHEMISTRY. Das, H. A.; van Ooyen, J. (Stichting Reactor Centrum Nederland, Petten). pp 25-38 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

The separation of the rare earths from other, possibly interfering, elements by liquid-liquid extraction is outlined and the spectrophotometric analysis of the total rare earths is briefly described. The mutual separation of the rare earths by cation exchange is discussed and anion exchange methods are also briefly treated. The applications of both cation and anion techniques in activation analysis are described. Separation by high-pressure cation exchange is then presented and the equipment used described. Finally separation by extraction and electrophoresis on paper strips is discussed. (INIS)

18098 ION-EXCHANGE SELECTIVITY COEFFICIENTS IN THE EXCHANGE OF CALCIUM, STRONTIUM, COBALT, NICKEL, ZINC, AND CADMIUM IONS WITH HYDROGEN ION IN VARIOUSLY CROSS-LINKED POLYSTYRENE SULFONATE CATION EXCHANGERS AT 25°C. Reddy, M. M.; Mainsky, J. A. (State Univ. of New York, Buffalo). J. Macromol. Sci., Part B; 5: No. 1, 135-158(Mar 1971). (COO-3469-9).

The ion-exchange selectivity parameters for the exchange of trace calcium, strontium, cobalt, nickel, zinc, and cadmium ions with hydrogen ion in crosslinked polystyrene-sulfonic acid cation exchangers were determined from equilibrium ionic distribution measurements at 25°C in dilute solutions of perchloric acid and polystyrene-sulfonic acid. The selectivity behavior in perchloric acid solutions shows that the divalent ion is always preferred by the resin phase. The selectivity coefficients are a smooth function of resin phase concentration, increasing with concentration for Sr^{2+} more than for Ca^{2+} and Cd^{2+} and being practically independent of resin phase concentration for Co^{2+}, Ni^{2+}, and Zn^{2+}. The selectivity coefficients measured in salt-free solutions of polystyrene-sulfonic acid show a marked dependence on the polyelectrolyte concentration, the divalent ion being preferred by the aqueous phase. This preference diminishes with the concentration of polyelectrolyte. These results are interpreted by resort to the Gibbs-Duhem equation. This thermodynamic analysis has been facilitated by the availability of osmotic coefficient data for the pure polyelectrolyte ion forms over a large concentration range. Ion-exchange selectivity predictions by using this approach accurately reflect the observed ion-exchange selectivity behavior. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 18135, 18395, 18396, 18852, 20422, 20520, 20523, 20524, 20528, 20565, and 20566.

18099 (AECL-4577) THERMODYNAMICS OF SELECTED TRANSITION METAL FERRITES IN HIGH TEMPERATURE AQUEOUS SYSTEMS. Rummery, T. E.; Macdonald, D. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25. AECL $1.50.

Thermodynamic data for the formation, reduction and oxidation of $NiFe_2O_4$, $CoFe_2O_4$, $CuFeO_2$ and $CuFe_2O_4$ are examined for aqueous systems containing dissolved hydrogen and oxygen at temperatures to 300°C. The data are presented as equilibrium partial pressures of oxygen and hydrogen for specific reactions. This information is used to predict which ferrites will form, and are stable, in aqueous systems containing known concentrations of oxygen and hydrogen, and the results are compared with x-ray diffraction data of corrosion products removed from the heat transport system of the Douglas Point Generating Station. The value of the equilibrium partial pressure data in predicting conditions required for "redox" cycling decontamination is outlined. (auth)

18100 (CONF-720735-(Absts.)) ABSTRACTS OF THE THIRD INTERNATIONAL CONFERENCE ON NONAQUEOUS SOLVENTS, EAST LANSING, MICHIGAN, JULY 5–7, 1972. (Michigan State Univ., East Lansing (USA)). 1972. 109p.

From third international conference on nonaqueous solvents; East Lansing, Michigan, USA (5 Jul 1972).

Fifty-nine abstracts are included on the chemistry of nonaqueous solvents, including mixtures of water with them. One covered ^{35}S exchange in SO_2–thionyl fluoride. (DLC)

18101 (COO-3186-1) SUMMARY OF ACHIEVEMENTS AND CONTRIBUTIONS IN THE FIELD OF CHELATE CHEMISTRY OF β-DIKETONES WITH TRANSITION AND RARE EARTH METALS. Final Report. Cefola, M. (Fordham Univ., New York (USA). Dept. of Chemistry). Oct 1973. Contract AT(11-1)-3186. 5p. Dep. NTIS $3.00.

18102 (ORO-3797-38) LANTHANIDE IONS AS SENSITIVE PROBES IN INTERMOLECULAR ENERGY TRANSFER AND ORGANIC PHOTOCHEMISTRY. Annual Progress Report. Filipescu, N. (George Washington Univ., Washington, D. C. (USA). Dept. of Chemistry). Jan 1974. Contract AT(40-1)-3797. 67p. Dep. NTIS $5.50.

Research progress is reported in the following areas: (1) the spectroscopic properties and behavior of positively charged organic sensitizers, for lanthanide ion energy acceptors, (2) distant interaction between nonconjugated electronic systems in rigid model molecules, (3) generation of stable paramagnetic species from selected organic heterocyclic energy donors, (4) preliminary experiments of hydroxycarbonium ion-europium energy transfer, and (5) photochemical reactions of donors of excitation energy competing effectively with transfer of energy to lanthanide acceptors. Titles of preprints and manuscripts attached to the report are: "Electronic Absorption and Emission of Aromatic Hydroxycarbonium Ions," "On the Configuration of Dienestrol," "Through-Space Interaction Between Nonconjugated Napthalene and Phenanthrene in a Rigid Molecule," and "Formation of Long-Lived Free Radicals from Acylpyridinium Salts with Alkali." (DHM)

18103 SURFACE OXYGEN SPECIES ON ISOTOPICALLY LABELLED OXIDE SURFACES. Tench, A. J.; Kibblewhite, J. F. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Chem. Soc., Chem. Commun.; No. 24, 955-956(19 Dec 1973).

Isotopic labelling of surface oxide ions has been used to show that radical ions such as $(O^-)_s$ and $(O_2^-)_s$ can exist on the surface of MgO as isolated ions and are not part of complex molecular ions which involve surface oxide ions. ESR studies are reported. (auth)

18104 METHOD FOR STUDYING THE LIBERATION OF A RADIOPROTECTIVE AGENT (AET) BOUND TO PROTEINS AS A MIXED DISULFIDE. Horvath, M.; Mannervik, B. (Univ. of Stockholm). Acta Chem. Scand.; 27: No. 3, 1083-1084(1973).

A method, based on the use of ion exchangers in small columns, is described for studying the release of the radioprotective agent s-2-aminoethylisothiouronium bromide (AET) bound [as an isomer 2-mercaptoethylguanidine, (MEG)] via a disulfide linkage to proteins. (LK)

18105 ADVANCES IN MOLTEN SALT CHEMISTRY. Volume 2. Braunstein, J.; Mamantov, G.; Smith, G. P. (eds.). New York; Plenum Publishing Corporation (1973). 267p. $20.00.

The following topics are considered: physical properties of molten organic salts, solubilities of reactive gases in molten salts, high-temperature coordination chemistry of Group VIII, and a review of recent developments in electroanalytical chemistry in molten salts. Separate abstracts were prepared for each of the four chapters. (LK)

For abstracts of individual chapters see: 18106–18109.

18106 MOLTEN ORGANIC SALTS: PHYSICAL PROPERTIES. Lind, J. E. Jr. (Stanford Univ., CA). pp 1-26 of Advances in Molten Salt Chemistry. Vol. 2. Braunstein, J. (ed.). New York; Plenum Publishing Corp. (1973).

The thermodynamic and transport properties of molten organic salts are discussed as a means of studying the structure of simple ionic fluids. The advantage of studying organic salts is their low

melting points and the possibility of tailoring their size and shape. (LK)

18107 SOLUBILITIES OF REACTIVE GASES IN MOLTEN SALTS. Flengas, S. N.; Block-Bolten, A. (Univ. of Toronto). pp 27-81 of Advances in Molten Salt Chemistry. Vol. 2. Braunstein, J. (ed.). New York; Plenum Publishing Corp. (1973).

Reactive gases have a relatively high solubility in molten salts at high temperatures. Inert and noble gases are less soluble. It is possible to distinguish between reactive and inert gas solubility by their temperature dependence. Solubilities decrease with increasing temperature for the former and increase for the latter. A thermodynamic treatment of solubility is given. Experimental techniques for measuring solubilities of gases in molten salts are discussed and tables of solubility data are included. (LK)

18108 HIGH-TEMPERATURE COORDINATION CHEMISTRY OF GROUP VIII. Johnson, K. E. (Univ. of Saskatchewan, Regina); Dickinson, J. R. pp 83-198 of Advances in Molten Salt Chemistry. Vol. 2. Braunstein, J. (ed.). New York; Plenum Publishing Corp. (1973).

Electron spectroscopy was used to study the coordination of Group VIII metal ions at high temperature. The relationships between the stationary electronic states of free atoms and ions are discussed. Cubic coordination, cubic coordination with spin-orbital coupling, quadratic coordination, and linear coordination are discussed in the section on bonding in and spectra of polyatomic species. (LK)

18109 ELECTROANALYTICAL CHEMISTRY IN MOLTEN SALTS: A REVIEW OF RECENT DEVELOPMENTS. Fung, K. W.; Mamantov, G. (Univ. of Tennessee, Knoxville). pp 199-254 of Advances in Molten Salt Chemistry. Vol. 2. Braunstein, J. (ed.). New York; Plenum Publishing Corp. (1973).

Electroanalytical chemistry in molten salts is discussed. Recent developments (1965–1971) in several important solvent systems are stressed. Solvent systems that are important now include LiCl–KCl, NaCl–KCl, and chloroaluminates. (LK)

18110 STRUCTURE OF CONTINUOUS DEPOSITS OF MOLYBDENUM OBTAINED FROM THE ELECTROLYSIS OF THE MELT KCl–K_3MoCl_6. Baraboshkin, A. N.; Saltykova, N. A.; Talanova, M. L; Martem'yanova, Z. S. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; 18: 87-93(1972). (In Russian).

A study was made of the influence of electrolysis parameters on the structure of the continuous deposition of Mo prepared from a melt containing KCl and K_3MoCl_6. The electrolysis was carried out under an atmosphere of argon. The precipitate was studied metallographically and by x-ray analysis. The thickness was determined from the increase in weight. The radial texture was studied by the ARKHAROV method. The feasibility was demonstrated for preparing deposits of high-purity Mo having a thickness of a few mm from strictly chloride melts. For this, it is necessary to use high-purity salts as a starting material and high-purity inert gas to separate the anolyte from the catholyte. A number of materials, such as graphite, W, Pt, Sr, Pd, Au, Ha, Fe, Ni, and Ag can be used for the cathode and strongly cohesive precipitates can be obtained from chloride oxide melts. The texture of the growth is type 3. It is produced by relatively high rates of growth of the grain having orientation of III perpendicular to the substrate such that it is actually related to it by a twin structure. (Referativnyi Zh.)

18111 P-v-T PROPERTIES FOR SUPERHEATED HEAVY WATER VAPOUR (660 to 760°F AND 1030 TO 2130 PSIA). Ivey, C. M.; Tarasuk, J. D. (Univ. of Western Ontario, London). Trans. Can. Soc. Mech. Eng.; 1: No. 2, 115-116(Jun 1972).

P-v-T properties are tabulated for superheated heavy water vapor (660 to 760°F and 1030 to 2130 psia). In this range, pressure values are in agreement with experimental data to 1.0%. The tabulated values are based on an equation of state fitted to existing experimental data. (auth)

Isotope Effects

Refer also to abstracts 18137, 18145, 18152, 18153, 18194, and 18201.

18112 ADDITION OF 2,4-DINITROBENZENESULFENYL CHLORIDE TO 1-PHENYLPROPYNE AND RELATED COMPOUNDS. Okuyama, T.; Izawa, K.; Fueno, T. (Osaka Univ.). J. Org. Chem.; 39: No. 3, 351-354(8 Feb 1974).

Electrophilic additions of 2,4-dinitrobenzenesulfenyl chloride (1) to 1-phenylpropyne (4) and its ring-substituted derivatives (p-OCH_3, p-Cl, and m-Cl) have been studied kinetically in acetic acid. The effects of the ring substituents on the reaction rate of 4 conformed to the Hammett $\rho\sigma$ relationship with the reaction constant $\rho = -1.46$ at 40°. Additions of 1 to phenylacetylene (5), 1-hexyne (7), and 2-heptyne (6) were also studied for the sake of comparison. It was found that the methyl substitution on the acetylenic carbon enhances the reactivity by a factor of 10 to 20. The secondary kinetic isotope effects were examined for 5 and styrene (10) with use of α- and β-deuterated substrates. The value $k_H/k_D \sim 0.95$ for each deuteration was obtained. These results were compared with those found in the related electrophilic addition reactions. It is concluded that the sulfenyl sulfur attacks the isolated π bond of phenylacetylenes to form an unsaturated episulfonium ion. (auth)

18113 SECONDARY DEUTERIUM ISOTOPE EFFECT AND SOLVENT EFFECT IN THE THERMAL REARRANGEMENT OF 2-ALLYLOXYBENZOTHIAZOLE AND SOME RELATED COMPOUNDS. Takahashi, T. (Sumitomo Chemical Co. Ltd., Osaka); Okaue, Y.; Kaji, A.; Hayami, J. I. Bull. Inst. Chem. Res., Kyoto Univ.; 51: No. 3, 173-181(May 1973). (In Japanese).

Thermal rearrangement of 2-allyloxybenzothiazole, 2-allyloxythiazole, and of 2-cinnamyloxybenzothiazole gave the corresponding N-alkenylbenzothiazoline-2-one and N-alkenylthiazoline-2-one in an excellent yield. The normal secondary kinetic isotope effect was observed for 2-allyl-1′,1′-d_2-oxy derivative while the inverse isotope effect was observed for 2-allyl-3′,3′-d_2-oxy derivative. Solvent effects were studied with 2-allyloxybenzothiazole and no significant effect was observed. The γ-phenyl group in the allyloxy moiety enhances the rate of the rearrangement. On the other hand, the introduction of the γ-phenyl or γ-methyl group in the allylthio moiety of the 2-allylthiobenzothiazole retarded the rate of the thermal rearrangement. (auth)

18114 RATES AND KINETIC HYDROGEN ISOTOPE EFFECTS FOR THE IONIZATION OF PHENYLNITROMETHANE. Keefe, J. R. (Univ. of Kent, Canterbury, Eng.); Munderloh, N. H. J. Chem. Soc., Chem. Commun.; No. 1, 17-18(2 Jan 1974).

The general-base catalyzed ionization of phenylnitromethane is subject to large primary kinetic hydrogen isotope effects; these effects, their activation parameters, and the Brønsted catalysis coefficient for the reaction are used to discuss possible transition-state structures. (auth)

18115 NUCLEAR MAGNETIC RESONANCE STUDIES OF THALLIUM(I)-205 IN AQUEOUS SOLUTION. Chan, S. O.; Reeves, L. W. (Univ. of Waterloo, Ont.). J. Amer. Chem. Soc.; 96: No. 2, 404-410(23 Jan 1974).

The relaxation (longitudinal and transverse) of thallium(I) ions in aqueous solution is observed to be independent of the resonance frequency, isotopic substitution in the solvent (D_2O for H_2O), the resonant spin (^{203}Tl for ^{205}Tl), the salt concentration, and the nature of the anions. It is, however, very sensitive to dissolved oxygen, and a linear dependence of the relaxation rate on the gas pressure up to 5 atm has been observed. It is concluded that, in oxygen-free solutions, Tl(I) is dominantly relaxed by the transient spin–rotation interaction and, in oxygenated solutions, by the electron–nuclear dipole–dipole interaction with considerable penetration of the hydration sphere by oxygen. No complex between the thallous ion and oxygen molecules appears to form as there is no appreciable increase in oxygen solubility in aqueous thallous solutions nor is there any appreciable shift in the Tl(I) resonance when the solutions are oxygenated. Solvent isotope shifts of thallium ions in light and heavy water have been determined. They are, contrary to other systems studied, rather dependent on the salt concentration and the nature of the anions. These observations are interpreted as a differential competition of various anions and solvent molecules in their interactions with the thallium ion. (auth)

18116 THREE-ELECTRON OXIDATIONS. VI. Chromic Acid Cooxidation of Cyclobutanol and Oxalic Acid. The Chromium (V) Oxidation of Cyclobutanol. Hasan, F.; Rocek, J. (Univ. of Illinois, Chicago). J. Amer. Chem. Soc.; 96: No. 2, 534-539 (23 Jan 1974).

The chromic acid cooxidation of cyclobutanol and oxalic acid yields only cyclobutanone and carbon dioxide with the CO_2 : cyclobutanone ratio varying from 1:1 to 4:1 depending on the initial ratio of the two substrates. The chromic acid oxidation in the presence of oxalic acid thus provides a quantitative method of converting cyclobutanol to cyclobutanone with complete suppression of ring cleavage side reactions. The chromium(V) oxidation of cyclobutanol yields cyclobutanone. The deuterium isotope effect of the reaction is $k_H/k_D = 4.96$. Cyclobutanol is only 2.3 times more reactive toward chromium(V) than isopropyl alcohol. A mechanism for the chromium(V) oxidation is proposed which is analogous to the mechanism of the chromium(VI) oxidation of alcohols and involves reversible formation of an ester intermediate and carbon–hydrogen bond cleavage in the rate-limiting

step. The presence of either acrylonitrile or acrylamide leads to polymer formation during the oxidation; however, with acrylonitrile, a constant 1:1 ratio of cyclobutanone:carbon dioxide is formed, whereas in the presence of acrylamide, the ratio of the two products is a function of the initial concentration of the substrates. The difference between the two monomers is interpreted in terms of different reactivity of the polymer radical toward oxidation. All results obtained in this study are fully consistent with the earlier proposed three-electron mechanism for the cooxidation reaction. (auth)

18117 DECOMPOSITION OF TERT-BUTYLPEROXY ISOBUTYRATE AND ISOTOPIC DERIVATIVES. Koenig, T.; Huntington, J. G. (Univ. of Oregon, Eugene). J. Amer. Chem. Soc.; 96: No. 2, 592-594(23 Jan 1974).

Methods for measuring deuterium secondary kinetic isotope effects in perester and peroxide decompositions were developed with the twofold purpose of gaining a better understanding of the origin of these effects and of extending their use as mechanistic probes. Results from the decomposition of tert-butylperoxy isobutyrate indicates a concerted conversion of the isobutyrate to the isopropyl-tert-butoxy radical pair through a reaction coordinate involving a single transition state, which accounts for 99% of the overall reaction. (LK)

18118 STUDIES OF THE SELF-ASSOCIATION AND SOLVENT-ASSOCIATION OF CHOLESTEROL AND OTHER 3β-HYDROXY-STEROIDS IN NONPOLAR MEDIA. Feher, J. J.; Wright, L. D.; McCormick, D. B. (Cornell Univ., Ithaca, NY). J. Phys. Chem.; 78: No. 3, 250-255(31 Jan 1974).

The concentration and temperature dependence of the hydroxyl proton chemical shift of cholesterol in $CDCl_3$ are interpreted in terms of equilibria among three species: cholesterol monomer, cholesterol dimer, and cholesterol monomer associated with solvent. Equations are derived, which allow the determination of equilibrium constants and, therefore, thermodynamic properties of various species. These equations require the chemical shift extrapolated to zero concentration and the limiting slope, both obtained at various temperatures, as experimentally determined parameters. The enthalpy change upon solvent complexation of the monomer is −0.9 kcal/mol and the enthalpy change of dimerization is −2.6 kcal/mol. Equal slopes in the plot of chemical shift vs concentration are shown to indicate equal equilibrium constants. (auth)

18119 MECHANISM OF THE TSCHITSCHIBABIN REACTION. Kessar, S. V.; Nadir, U. K.; Singh, M. (Punjab, Univ., Chandigarh, India). Indian J. Chem.; 11: No. 8, 825-826(Aug 1973).

On the basis of the small isotopic effect (k_H/k_D) in the Tschitschibabin reaction of pyridine and the formation of a dihydro derivative in the case of phenanthridine, it is proposed that this reaction can proceed through two mechanisms like the Cannizzaro reaction. (auth)

18120 APPLICATION OF ISOTOPE EFFECT IN THE DETERMINATION OF OPTIMUM TEMPERATURE FOR COMPETITIVE REACTIONS. Pradhan, D. G. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Chem.; 11: No. 9, 894-895(Sep 1973).

An increase in the isotope effect with rise in temperature is observed for the iodination of aniline-2,4,6-d_3 and phenol-2,4,6-d_3. This has been attributed to a small difference in activation energies between the competitive ortho- and para-substitutions, isotope effect being observed only during ortho-substitution due to steric hindrance. Isotope effect increases up to a temperature above which contribution from the reaction having higher activation energy is the maximum and then decreases due to usual temperature effect. This type of temperature maximum is not observed for the iodination of nitrobenzene-d_5 as the difference in activation energies between ortho- and meta-substitution is high. (auth)

18121 RING STRAIN AND GENERAL ACID CATALYSIS OF ACETAL HYDROLYSIS. Lysozyme Catalysis. Atkinson, R. F.; Bruice, T. C. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 96: No. 3, 819-825(6 Feb 1974).

The hydrolysis of 2-methoxy-3,3-dimethyloxetane (7) occurs with general acid catalysis as attested to by: (1) dependence of observed rate constant upon the concentrations of acid species in solution (Brønsted $\beta = -0.65$); (2) the near identity of catalytic coefficients for dihydrogen phosphate anion and imidazolium ion; and (3) the values of the deuterium solvent kinetic isotope effects for H_3O^+ and $H_2PO_4^-$ ($k_D/k_H = 1.8 \pm 0.9$ and 0.50 ± 0.10, respectively). These results establish that the proposed ring strain in the Phillips mechanism for lysozyme would allow general acid-catalyzed hydrolysis of the glycosidic bond. (9 figures, 4 tables) (auth)

18122 CALORIMETRIC AND SPECTROPHOTOMETRIC COMPARISON OF ADDUCTS OF PHENOL AND DEUTERIOPHENOL. Boettcher, J. W.; Drago, R. S. (Univ. of Illinois, Urbana). J. Phys. Chem.; 78: No. 4, 429-431(14 Feb 1974).

Calorimetrically measured enthalpies of the hydrogen bonding interaction of C_6H_5OH and C_6H_5OD with acetone and quinuclidine showed no detectable difference in the enthalpies of adduct formation of a given donor with either acid. An infrared analysis of the shift in the OH and OD vibrations upon hydrogen bonding leads us to conclude that no difference is to be expected in the enthalpy of adduct formation for interactions in the range from 0 to 10 kcal mol^{-1}. (auth)

18123 MODEL CALCULATIONS OF THE HYDROGEN/DEUTERIUM KINETIC ISOTOPE EFFECT IN THE H + Si_2H_6 REACTION. Safarik, I.; Pollock, T. L.; Strausz, O. P. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 78: No. 4, 398-401 (14 Feb 1974).

Model studies within the framework of transition-state theory were carried out for the computation of the H/D kinetic isotope effect in the displacement reaction of H atoms with disilane, H + $SiH_3SiH_3 \rightarrow SiH_4 + SiH_3$. Results using full normal coordinate analysis suggest that the displacement of the silyl radical proceeds via a bridged activated complex (I) and not a linear intermediate. The isotope effect is shown to arise from force constant changes during passage from reactants to the activated complex as a result of three different sources: (a) geometrical alterations, (b) an increase in the number of normal modes, and (c) cancellation of interaction forces. (4 tables) (auth)

18124 α-DEUTERIUM ISOTOPE EFFECT FOR DISPLACEMENT OF THE NITRATE GROUP. Koshy, K. M.; Robertson, R. E. (Univ. of Calgary, Alberta). J. Amer. Chem. Soc.; 96: No. 3, 914-916(6 Feb 1974).

Kinetic α-deuterium effects were determined for the solvolytic displacement of the nitrate group from a series of benzyl nitrates, isopropyl nitrate, and cyclopentyl nitrate in water. Trends and probable mechanisms are discussed. Results indicate that the transition state for nitrate is more ionic than that for chloride. (DLC)

Isotope Exchange and Isotope Separation

18125 PHOTOLYSIS OF HYDROGEN SULFIDE IN THE PRESENCE OF DIMETHYLSILANE. Alexander, A. G.; Fair, R. W.; Strausz, O. P. (Univ. of Alberta, Edmonton). J. Phys. Chem.; 78: No. 3, 203-207(31 Jan 1974).

The photolysis of H_2S in the presence of $(CH_3)_2SiD_2$ leads to the formation of large yields of D_2. The apparent exchange reaction is due to a photochain sequence involving $(CH_3)_2SiDSH$ and $(CH_3)_2SiDS\cdot$ as reactive intermediates. The transient presence of the silylthiol was indeed confirmed by flash photolysis experiments using kinetic mass spectrometry and kinetic absorption spectroscopy. Abstraction of hydrogen from the methyl groups by H atoms and the direct exchange reaction, H + $(CH_3)_2SiD_2 \rightarrow (CH_3)_2SiDH + D$, are unimportant at room temperature when the H atom possesses translational energy in the 0 to 35 kcal/mol interval. (auth)

18126 CHEMICAL EVOLUTION OF A NITROGENASE MODEL. VII. The Reduction of Nitrogen. Schrauzer, G. N.; Kiefer, G. W.; Tano, K.; Doemeny, P. A. (Univ. of California, San Diego, La Jolla). J. Amer. Chem. Soc.; 96: No. 3, 641-652(6 Feb 1974).

Nitrogenase model systems composed of molybdate and thiol ligands such as L(+)-cysteine reduce molecular nitrogen to ammonia slowly in the presence of $NaBH_4$ as the reducing agent. In the presence of substrate amounts of ATP, the reduction of nitrogen is significantly stimulated but leads to the accumulation of diimide in the reaction solutions. The diimide decomposes or disproportionates to nitrogen, hydrogen, and hydrazine and is not reduced as such. The ammonia produced in all reactions arises primarily from the reduction of hydrazine. These observations were confirmed by independent experiments with diimide generated by the decomposition of azodicarboxylate and with hydrazine. Diimide is not a substrate for molybdothiol catalyst systems, while hydrazine is catalytically reduced to ammonia. Molybdothiol catalysts promote D_2-H^+ exchange most efficiently in the presence of nitrogen as the substrate; they thus parallel nitrogenase also in this respect. The D_2-H^+ exchange reaction is presumably linked to the formation and decomposition of diimide in both the nitrogenase enzyme and its models. The current molybdothiol model systems were furthermore expanded to include ferredoxin-type complexes as electron-transfer catalysts. This provided new catalytically active systems containing molybdenum, iron, labile sulfide, and RSH components in proportions similar to that observed in native nitrogenase.

The new model systems catalyze the reduction of, e.g., acetylene efficiently even with $S_2O_4^{2-}$ as the reducing agent and thus duplicate nitrogenase in yet another important respect. (12 tables, 6 figures) (auth)

18127 ISOTOPIC EXCHANGE REACTIONS BETWEEN NITROGEN OXIDES AND OXYHALIDES. Sharma, H. D.; Sood, S. P. (Univ. of Waterloo, Ont.). J. Phys. Chem.; 78: No. 4, 402-405(14 Feb 1974).

The kinetics of atom exchange reactions among ClNO, NO, and NO_2 were studied using a time-of-flight mass spectrometer in two reactors of different surface-to-volume ratio, over a temperature range of 0 to 23°. The reactions proceed according to the equations $Cl^{14}NO + {}^{15}NO_2 \rightarrow Cl^{15}NO_2 + {}^{14}NO$, $Cl^{14}NO + {}^{15}NO_2 \rightarrow Cl^{15}NO + {}^{14}NO_2$, $Cl^{14}NO + {}^{15}NO \rightarrow Cl^{15}NO + {}^{14}NO$, with the second-order rate constant, $k = (1.78 \pm 0.04) \times 10^5 \exp[-(3350 \pm 150)/T]$ M^{-1} sec^{-1} for the first two reactions and $k = (1.64 \pm 0.10) \times 10^6 \exp[-(3145 \pm 150)/T]$ M^{-1} sec^{-1} for the last reaction. Bimolecular mechanisms for the reactions are proposed similar to those for the corresponding reactions in $NO-NO_2$ and NO_2-NO_2 systems. However, the rates of reactions in the present systems are slower by a factor of ~10^6 at 23°. (auth)

18128 KINETICS OF ISOTOPE EXCHANGE AT EQUILIBRIUM FOR A ONE SUBSTRATE-ONE PRODUCT ENZYME MECHANISM. Darvey, I. G. (Univ. of Sydney). J. Theor. Biol.; 42: No. 1, 55-62(5 Nov 1973).

It is shown that the general solution of Morales, Horovitz and Botts [Archs. Biochem. Biophys.; 99: 258 (1962)] describing isotope exchange kinetics at equilibrium for the one substrate-one product enzyme mechanism: $E + S \rightleftharpoons X \rightleftharpoons E + P$, reduces to the steady-state solution normally applied to experimental data, under usual experimental conditions. The analysis provides a firmer theoretical basis for the equations generally used in analyzing kinetic data from isotope exchange experiments. (auth)

Feed Materials Processing

Refer also to abstracts 18035, 18261, 18262, 18264, and 20329.

18129 (IEA-287) PURIFICATION OF URANIUM BY SELECTIVE SORPTION OF URANYL CHLORIDE ON ANION RESIN. Gochnarg, I.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Feb 1973. 27p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $3.50.

A technique for the transformation of crude sodium diuranate (SDU) into nuclear grade ammonium diuranate (ADU) is described. HCl is used for the dissolution of SDU with the purpose of exploring the selective sorption of uranyl anionic chlorocomplexes on a strong anionic ion exchanger column. The uranyl chloride is acid deficient and receives the addition of NaCl as a supplier of Cl^- ligand. The uranium from 80 g U/l solutions 5M in NaCl, pH 1.0-1.5, is sorbed onto an anionic ion exchanger column, the resin washed after with alcohol. The decontamination of phosphate is achieved by addition of Al^{3+} to the influent and to the alcohol used for washing. The decontamination of Fe(III) and Cd(II) does not present any problem. The retention of Mo(VI) by the resin is practically complete and it is not eluted with uranium. The uranyl chloride is eluted with water. The eluted solution containing in media 100 g U/l is precipitated with NH_3 in the presence of EDTA. Molybdenum is eluted after uranium, with dilute HCl. The procedure allows efficient decontamination of several impurities, such as thorium, rare earths, cadmium, iron, boron, phosphate, silicate, molybdenum, alkali metals, alkaline-earth metals, and others that accompany the uranium in its concentrate proceeding from the industrial processing of monazite. (auth)

18130 (IEA-291) STUDIES ON THE BENEFICIATION OF MOLYBDENUM AND URANIUM IN SULFURIC LIXIVIATION OF ORES. Part I. Separation of Mo(VI)-U(VI) Pairs by Sorption of Molybdenum on Weakly Anionic Resin and Fixation of Uranium on Strongly Anionic Resin. Part II. Separation of Mo(VI)-U(VI) Pairs by Adsorption of Molybdenum on Coal and Sorption of Uranium on Strongly Anionic Resin. Matsuda, H. T.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1973. 40p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $4.00.

The separation of uranium from molybdenum is described. The complex sulfates of U(VI) and Mo(VI) and their affinity for anionic ion exchangers, and the adsorption of Mo on activated charcoal were studied. This strong sorption of molybdenum on the strong anionic resin, much more pronounced than for the complex uranyl sulfate, is the most serious problem for this separation of both elements. The difference in the affinities of Mo(VI) and U(VI) led to a very difficult elution of Mo which has the tendency to remain in the resin as a poisoner. This difficulty was overcome by the sorption of Mo(VI) in a weak anionic resin. The experiments pointed out that the Mo sorption in the weak resin is lower than in a strong one, but its retention is still high and could be used for its separation from uranium. Mo is more easily eluted from the weak anionic resin with NaOH solution than from the strong anionic resin. On the other hand, the sorption of complex uranyl sulfate in anionic resin is considerably lower than in a strong one. This difference in behavior of Mo(VI) and U(VI) in sulfuric medium make possible the separation of both elements using two columns, the first one for the retention of molybdenum in a weak ion exchanger and the second for the sorption of uranyl sulfate in a strong anionic exchanger. However, this scheme allows only a good enrichment of Mo in the weak resin and of U in the strong resin. The fixation of Mo in the first column is not selective and its elution is not complete as well, always residual Mo remaining in the resin. This enrichment of U and Mo does not give a satisfactory resolution for the separation of both elements. This difficulty was overcome by a separation scheme, Mo being selectively adsorbed on an activated charcoal column and the effluent percolated through a strong ion exchanger for the sorption of uranyl sulfate. Molybdenum is easily eluted with dilute sodium or ammonium hydroxide. Uranium is eluted with NH_4NO_3 1.0M-HNO_3 0.1M. The proposed scheme applied to a semipilot scale led to satisfactory results for the separation, concentration, and recovery of Mo and U from the sulfuric liquors of Morro do Agostinho ore, Minas Gerais in Brazil. (auth)

18131 (ORNL-TM-4443, pp vp Paper 30) PURES: PROBABILISTIC URANIUM REQUIREMENTS ESTIMATING SYSTEM. Walters, D. H. (Tennessee Valley Authority, Chattanooga). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

Under the new AEC fixed commitments contracts, utility fuel managers must determine the quantities of separative work needed for their system on a basis of 8 years in advance for a 10-year period. The object of this program is to establish statistically the expected values and the associated confidence limits of the separative work and fuel material requirements which will result from a planned utility operation. The method involves assuming a probability density function that reflects the occurrence of operational problems and then simulating the operational history of each reactor in the system. During each simulation, events are generated which model the various reactors deviating from an ideal plan. By monitoring these modified fuel requirements statistics are generated which describe the way the quantities of fuel can vary. These statistics, in turn, are used to determine the initial contractual commitments for enrichment services and U_3O_8 requirements and to describe any required adjustments in order to minimize cost while considering the uncertainties involved. (9 references) (auth)

18132 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR RECOVERING URANIUM VALUES FROM ORES. Smith, S. E.; Lapage, R.; Garrett, K. H. (to United Kingdom Atomic Energy Authority). British Patent 1,328,242. 30 Aug 1973. Filed Date 21 May 1970. 10p.

A process is described for extracting U from ores containing the U as finely disseminated refractory minerals, such as brannerite, secondary uraninites, davidite, uranothorite, monazite, etc. Disadvantages of conventional processes are stated, and a process is described that overcomes these disadvantages to a large extent, including elimination of the need for fine grinding, the requirement for large agitated tanks and for a large-scale liquid/solid separation stage. The process comprises the following steps: (1) grinding the ore to a top size not substantially smaller than 1 mm, and preferably to 1.4 mm, (2) mixing the ground ore with > 4N H_2SO_4 in sufficient quantity to wet the ore without forming a continuous liquid phase, (3) heating the mixture to 65 to 100°C and allowing it to "cure" at an elevated temperature, and (4) contacting the "cured" mixture with a liquid to elute the U. The liquid content of the mixture is preferably about 100 cc per kg of dry ore, and the acid may be sprayed onto the surface of the ore in a drum mixer. Heating may be effected by introduction of hot air or steam. An oxidizing agent, such as sodium chlorate and ferric sulfate, may be included in the mixture. Use of a "curing" container is desirable, through which the eluting liquid is percolated. The eluting liquid may be acidified water. Examples of application of the method are given. (UK)

Radiation Chemistry

Refer also to abstracts 18070, 18198, 18209, 18367, 18380, 18444, 18448, 18451, 18452, 18458, 18461, 18464, 18561, 18687, 19305, and 20527.

18133 (COO-1385-57) ELECTRON SPIN RESONANCE STUDIES OF RADIATION EFFECTS. Annual Progress Report, January 1, 1973–December 31, 1973. Rogers, M. T. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-1385. 11p. Dep. NTIS $3.00.

Progress is reported in studies of the effects of high-energy radiation, particularly γ rays, on nonmetallic solids. Electron spin resonance spectroscopy (ESR) was used to identify paramagnetic species produced, study their molecular and electronic structures, and follow their reactions and decay. Fundamental processes in the radiation chemistry of solid organic and inorganic compounds were studied by ESR. A wide variety of materials were examined to identify the more stable paramagnetic products and search for general principles governing radiation damage. Structure and bonding in radicals were deduced from the ESR parameters. Specific studies have been submitted for publication or have already been published. (JGB)

18134 (JAERI-M-5333) RADIOLYSIS OF DEHPA AND DEHPA IN KEROSENE OR CCl_4 AND ITS EFFECT ON THE Sr^{2+} EXTRACTION. Tachimori, S.; Sato, A.; Nakamura, H.; Amano, H. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. 15p. (In Japanese). NTIS (U. S. Sales Only).

Gamma-ray irradiation of di(2-ethylhexyl)phosphoric acid (DEHPA) causes the formation of mono(2-ethylhexyl)phosphoric acid (MEHPA) and 2-ethylhexyl alcohol. G value for the MEHPA formation is 1.88. Irradiation of DEHPA to the dose of 100 Wh/l reduces the distribituon ratio for Sr^{2+} from 14 to 10 or lower. The radiolytic formation of MEHPA is depressed by irradiation of the DEHPA in kerosene, but Sr^{2+} extraction is similar to the case of DEHPA alone. Decomposition of DEHPA is increased considerably when diluted with CCl_4 (G value for the decomposition of DEHPA is about 70); chloroform and other chlorinated compounds in addition to MEHPA are produced. The distribution ratio for Sr^{2+} at 100 Wh/l is then lowered to 5 or smaller. (auth)

18135 (JUL-978-NC) DETECTION OF LIGAND CRYSTAL DEFECTS IN CRYSTALLINE HEXAHALOGENO-RHENATES. Pross, L. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). Jul 1973. 93p. (In German). Dep. NTIS (U. S. Sales Only) $6.75.

In crystalline hexahalogen complexes of Re(IV) of the type $K_2[ReX_6]$ X = Cl, Br, the generation of metastable ligand crystal defects $[ReX_5$ defect$]^-$ by thermal ligand dissociation and irradiation with high-energy particles was studied with the aid of optical spectrometry and radiochemical methods. The absorption of $K_2[ReCl_6]$ monocrystals in the visible and near IR region (5,000–14,000 A) was determined in the temperature range of 4.2–513°K. The fine structure of the bands could be assigned to the single vibrational states by means of the low temperature spectra. In the thermal decomposition of $K_2[ReBr_6]$–$K_2[ReCl_6]$ mixed crystals in the composition 1 : 1, studied at 200°C up to 170 hr, oxidation products like ReO_4^- and complexes poor in halide ligands are formed, e.g., $[ReCl_5$ defect$]^-$. This could be shown by electrophoretic separation of ^{186}Re-labelled complexes and by measuring the distribution of radioactivity. By means of the decomposition kinetics, the percentage concentration of these disturbed complexes in the thermal equilibrium at 473°K was determined to be 5% of the hexachloro-component and a maximum of 20% of the hexabromo-component. The ligand defects are finally removed out of the equilibrium by some kind of a scavenging reaction by the diffusion of the oxygen contained in the air. The generation of ligand defects by adiabatic processes in disks of monocrystals of $K_2[ReCl_6]$ at 77°K was studied by bombardment with 3-MeV electrons. The detection of metastable ligand defects in suitable systems, like $K_2[ReBr_6]$–$K_2[ReCl_6]$ mixed crystals, is possible. (GE)

18136 (SZS-149) [RADIATION MONITORING, RADIATION CHEMISTRY, AND RADIOACTIVE WASTES]. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Mar 1973. 41p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Separate abstracts have been prepared for each of the three papers in this report. These papers cover radiation monitoring, radiation chemistry, and radioactive waste processing. (UK)

For abstracts of individual papers see: 18076, 18229, and 18474.

18137 REACTIONS OF HYDROGEN ATOMS IN AQUEOUS SOLUTIONS. Neta, P. (Carnegie–Mellon Univ., Pittsburgh). Chem. Rev.; 72: No. 5, 533-543(1972). (RRL-3238-370).

Radiolysis of aqueous solutions is the most utilized method for study of H atoms. Comparisons were made between reactions of H atoms and those of e^-_{aq}, OH, and organic radicals. The reactions of H and OH were found to follow the same pattern whenever hydrogen abstraction from an aliphatic compound or addition to an aromatic ring take place. The rate constants for abstraction are usually higher for OH than for H, and the selectivity of OH is lower. The isotope effect in the abstraction of H or D atoms from an aliphatic compound is also much larger for abstraction by H than for abstraction by OH. In their addition to an aromatic ring both H and OH behave as electrophiles, although the latter seems to have a more pronounced electrophilic character. Some functional groups react differently with H and OH mostly because of the redox properties of these radicals. Differences also exist between their reactivities toward inorganic compounds. By and large, H behaves as a reducing agent in these systems, but there are exceptions like the reaction of H with ferrous ions where an efficient oxidation takes place. In a way the $H + OH^-$ reaction can be looked upon as an acid-base process. The H atoms in aqueous solutions appear to be more selective than organic radicals, probably because of the slightly electrophilic nature of H. The reactions of H parallel those of e^-_{aq} only to a limited extent because the latter are pure electron transfer reactions whereas H atoms can react both by electron transfer and mainly by atom transfer. Differences between these two reactants, which may be considered as the acid and base of the same species, were found for several inorganic compounds (mainly cobalt complexes), for aromatic compounds, for haloaliphatic and other aliphatic compounds. (LK)

18138 MONTE CARLO SIMULATION OF RADIOINDUCED GRAFTING REACTIONS. 1. Polyethylene–Styrene System. Yasukawa, T.; Takahashi, T.; Murakami, K. (Tohoku Univ., Sendai). Tohoku Daigaku Hisuiyoeki Kagaku Kenkyusho Hokoku; 22: No. 2, 175-183(Dec 1972). (In Japanese).

When improvement of properties of polymers is attempted, number and length of grafting chains are the most basic factors affecting the properties of copolymers. The grafting reaction was analyzed by kinetic theory and molecular distribution of the grafting chains was investigated by simulating method. The method is a probabilistic simulation following the Monte Carlo method. Models accounting for the chain length dependence of coupling probability, and the effect of swinging and dispersion of growth rate were established. All calculations were carried out with a computer of NEAC 2200-model 700 in the large computer center, Tohoku University. Different distributions were obtained according to the models adopted in the calculation based on kinetic data for the grafting reaction of styrene to polyethylene obtained by the bromine-labeling method. (JA)

18139 DISINTEGRATION REACTION OF POLYMERS BY RADIATION AND ITS APPLICATION TO WASTE DISPOSAL. Kagiya, T. (Kyoto Univ.); Hagiwara, K. Shigen; No. 181, 40-44 (Jun 1972). (In Japanese).

Methods for the reasonable treatment of various polymer products must be developed. Polymers subjected to radiation produce two kinds of variation in their property, one of which is lowering of mechanical property due to the cut of main chains, and another is increase of mechanical strength because of new molecular bonding. The former is called disintegration type change, and the latter bridge type. The main factor determining the radiation effect is chemical change of active nuclides of the polymers produced by the radiation. Disintegration of the polymers is promoted by making the cut of main chains easier as mentioned above. Irradiation with the addition of special substances accelerates the lowering of strength; for example, treatment in air accelerates disintegration. The additives are introduced in coupled form with the polymers by reaction with polymer radicals under the irradiation. Change to carbonyl or unsaturation promotes photooxidation disintegration reaction due to the increase of photoabsorption. The photodisintegration of polyethylene is explained. (JA)

18140 ESR STUDIES ON THE YIELD OF PEROXY RADICALS IN PTFE IRRADIATED BY DEUTERONS. Abe, H.; Imaizumi, M.; Ono, K. (Tokyo Univ.). J. Phys. Soc. Jap.; 35: No. 5, 1366-1370 (Nov 1973).

Radicals in PTFE (polytetrafluoroethylene, Teflon) sheets irradiated by a 2-MeV deuteron beam in vacuum and exposed to air were studied by ESR at 9 GHz and at room temperature. An asymmetric line with a main peak of width 23 ± 1 gauss at g = 2.0174 ± 0.0007 was observed, which was very stable under open air at room temperature. This type of center was concluded to be the peroxy chain radicals. The number of radicals produced was concluded to be proportional to the number of incident deuterons, the yield being 2000 ± 420 radicals per one incident deuteron. However, the radical density comes to an upper limit of $(1.36 \pm 0.11) \times 10^{19}$ radicals/cm^3, or one radical per (3820 ± 304) C–F bonds, at a dose higher than $(3.43 \pm 0.45) \times 10^{15}$ deuterons/cm^2. (auth)

18141 TRAPPED ELECTRONS IN ORGANIC GLASSES. Higashimura, T. (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 38-57(Sep 1973).

In organic glasses, trapped electrons are formed in the early stage of radiolysis. The trapped electrons are precursors of solvated electrons in these matrices. Experimental results on the trapped electrons in various substances are reviewed and the nature of the trapped electrons is discussed. (auth)

18142 CORRELATION OF STRENGTH AND RELAXATION PROPERTIES OF POLY(METHYL METHACRYLATE) UNDER THE INFLUENCE OF RADIATION AND LIQUID MEDIA. Mamchich, S. D.; Tynnyi, A. N. (Inst. of Nuclear Research, Kiev). Fiz.–Khim. Mekh. Mater.; 9: No. 5, 31-33(1973). (In Russian).

During the investigation of the static fatigue of polymers as a consequence of localized relaxation process, stress assumptions were advanced on the presence of correlation bonds of the strength and relaxation properties of the polymer. This assumption confirmed tests on poly(methyl metacrylate) under the influence of irradiation and liquid media carried out in different regimes. (tr-auth)

18143 MOVEMENT OF ELECTRONS IN HYDROCARBONS. Schiller, R. (MTA Kozponti Fizikai Kutato Intezete, Budapest). Izotoptechnika; 16: No. 11, 611-616(Nov 1973). (In Hungarian).

The analysis of the electrical conductivity and radiation chemical behavior of irradiated liquid hydrocarbons indicates that the electrons in these liquids are localized with different probabilities. The extent of localization is determined by the energy fluctuations of the medium, hence the actual electron states depend both on the energy changes associated with the localization process and on the specific heats and compressibilities of the liquid. (auth)

18144 CHEMICAL EFFECTS OF GAMMA IRRADIATION IN SODIUM CHLORIDE WITH INCORPORATED IODIDE (^{131}I). Vlatkovic, M. (Institut Rudjer Boskovic, Zagreb). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

The effect of γ-irradiation in NaCl doped with a small amount of NaI(^{131}I) was studied in order to obtain information on the features and reactivity of molecular or ion-molecular species and other radiolytic defects created in the irradiated solid system. Simultaneously with the increase of color-center concentration radioactive iodide passes into a chemical form that follows iodate as determined by radiochemical analysis in the presence of periodate ions. The growth curves for iodine oxidation were studied as dependent on the dose and temperature of irradiation, and the presence of divalent cations and the purity of NaCl used for doping. Oxidation curves generally occur in two stages, which seems to indicate the importance of defects, (i.e., cation vacancies existing in the sample prior to irradiation). It is concluded that derivatives of V or V(k) centers (ICl or ICl_2^-) are responsible for the appearance of oxidized iodine. On isothermal annealing those species are reduced at a rate dependent on the total γ dose that the sample has received. This is presumably due to their competition in electron capture with other electron deficient centers formed in the halide by irradiation. It is believed that the results may contribute to a better understanding of the chemistry of recoil or implanted atoms in similar compounds. (GE)

18145 RADIOLYSIS OF HYDROCARBONS. Part 21. Radical and Non-Radical Mechanisms in n-Alkanes in the Liquid Phase. Rappoport, S.; Gaeumann, T. (Inst. of Chemical Physics, Lausanne). Helv. Chim. Acta; 56: No. 8, 2861-2879(1973). (In French).

Contributions of radical and non-radical processes were determined in the formation of radiolysis products of n-heptane, n-octane, n-nonane and n-decane in a large range of temperatures. Calculations are based on the combination and the dismutation of radicals, both reactions having nearly the same importance. Hydrogen abstraction reactions become important above −25°. Intermediate molecular weight products and dimers are formed by statistical combination of the various radicals resulting from C−C and C−H scission. At low temperature, low molecular weight products are formed by both radical and non-radical processes, the second one being more important (3/4 for alkanes and 2/3 for olefins). The yield of radicals increases with the chain length of the irradiated n-alkane and amounts to 4.5 for n-heptane and 6.8 for n-decane at −25°. This increase is due only to radicals from C−H scission, while the yield of radicals from C−C scission remains constant. Scission of CH_2-CH_2 bonds is favored for bonds inside the molecule, but this effect diminishes with chain length and CH_2-CH_2 rupture is equally probable at all positions for n-alkanes heavier than decane. Methyl C−H scission is 2.7 times less probable than methylene C−H scission. The radiolysis of mixtures of protonated and deuterated n-alkanes is shown to be able to give information concerning basic processes in radiation chemistry. (auth)

18146 EFFECT OF GAMMA-IRRADIATION ON FREE FATTY ACIDS. Beke, H.; Tobback, P. P.; Maes, E. (Univ. Louvain, Heverlee, Belgium). (1973). vp. (In Dutch).

From International colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Direct effects of gamma irradiation on model systems of fatty acids were studied. Experimental procedures are described and the radiolytic degradation products of trilaurin are discussed and compared with the findings of Nawar. Experiments conducted with fatty acids (lauric, myristic, palmitic, and stearic acids) are reported. The major hydrocarbons resulting from specific cleavage of fatty acids are quantitatively more important than those resulting from triglycerides. The radiolytic pattern of lauric acid promises use as a very adequate dosimeter. Finally, the fat composition and its radiolytic pattern in Belgian shrimp are discussed. (GE)

18147 RADIOLYSIS PRODUCTS OF LOW MOLECULAR WEIGHT PRODUCED BY GAMMA IRRADIATION OF CORN STARCH. Berger, G.; Dauphin, J. F.; Athanassiadis, H.; Saint-Lebe, L.; Agnel, J. P.; Rigouard, M.; Seguin, F. (CEN de Cadarache, France). (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

The aim of research work conducted in the Foodstuffs Preservation laboratory on the products of starch radiolysis is to expand and clarify the toxicological evaluation studies also carried out on microorganisms and higher animals. To date, aldehydes (formaldehyde, acetaldehyde, malonaldehyde), a ketone (acetone), alcohols (ethanol, methanol), sugars (maltose, glucose, mannose, fructose, galactose, ribose, arabinose, xylose, erythrose), an acid (formic acid), esters (probably lactons), and a peroxide (hydrogen peroxide) have been identified by one or several methods (colorimetric analysis, thin-layer, liquid, and gas chromatography, mass spectrometry, use of enzymes). Concentrations of most of them were measured as a function of the irradiation parameters (dose, up to 2 M rad, dose rate, atmosphere, temperature), the characteristics of the starch (hydration, impurities), storage conditions (temperature, length of time), and the effects of a heat treatment were compared with those of irradiation. A specific test for irradiation of starch, based on colorimetric analysis of malonic aldehyde, showed a dose of 25 krad, even after 3 months storage at normal temperature. A temporary degradation process of starch under irradiation and some mechanisms of formation are proposed. (GE)

18148 ELECTRON SPIN RESONANCE STUDY OF FREE RADICALS IN γ-IRRADIATED SINGLE CRYSTAL OF 1-METHYLCYTOSINE. Elliott, J. P. pp 17-22 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Free radicals formed in γ-irradiated single crystals of 1-methylcytosine have been studied by electron spin resonance. The radicals appeared to be quite stable over many months. A detailed interpretation of the obtained spectra is given and leads to the conclusion that the observed radicals are formed by addition of a hydrogen atom at C_5. The structure of this radical is briefly discussed. (INIS)

18149 CURIUM-244 α RADIOLYSIS OF NITRIC ACID. Oxygen Production from Direct Radiolysis of Nitrate Ions. Bibler, N. E. (E. I. du Pont de Nemours and Co., Aiken, SC). J. Phys. Chem.; 78: No. 3, 211-215(31 Jan 1974).

Dissolved ^{244}Cm was used as an α-particle source to study radiolytic evolution of oxygen and hydrogen at atmospheric pressure from aerated nitric acid or $NaNO_3$−0.4 M H_2SO_4 solutions. Dose rates were ~10^{18} eV/(ml min), and evolution rates were linear up to a maximum dose of ~10^{21} eV/ml. G values were dependent on nitrate ion concentration, and results were identical in either nitric acid or $NaNO_3$−0.4 M H_2SO_4 solutions. As nitrate ion concentration increased, $G(H_2)$ decreased and $G(O_2)$ increased. These results agree with published results using ^{210}Po as an α source, but contradict those with ^{239}Pu as an α source. Above 2 M NO_3^-, $G(O_2)$ increased linearly with the electron fraction of nitrate ion, and it is concluded that this increase is due to oxygen produced by direct radiolysis of nitrate ions. The 100-eV yield from this effect is estimated to be 2.2 in agreement with that obtained from γ radiolysis. Studies of gas evolution from solutions containing both ^{244}Cm and Pu(IV) showed that Pu(IV) does not affect $G(O_2)$. (auth)

18150 FORMATION OF POSITIVE IONS IN THE REACTION OF DISULFIDES WITH HYDROXYL RADICALS IN AQUEOUS SOLUTION. Moeckel, H.; Bonifacic, M.; Asmus, K. D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Phys. Chem.; 78: No. 3, 282-284(31 Jan 1974).

Dimethyl disulfide is oxidized by hydroxyl radicals to 44% according to $CH_3SSCH_3 + OH\cdot \rightarrow CH_3SSCH_3^+ + OH^-$. The formation of the positive disulfide ions could be demonstrated by the pulse radiolysis conductivity method; they are relatively long lived. In neutral and slightly acid solution the positive ions decay by a second-order process with $2k = (4.2 \pm 0.5) \times 10^9\ M^{-1}\ sec^{-1}$; in slightly basic solution neutralization by OH^- ions is observed. Similar results were obtained with other disulfides [alkyl disulfides, $(o\text{-}HOOCC_6H_4S)_2$, $(o\text{-}H_2NC_6H_4S)_2$, cystin, cystamin], whose reaction with hydroxyl radicals also leads partially to the formation of positive $RSSR^+$ ions. (auth)

18151 SOLVENT PARTICIPATION IN ELECTRON TRANSFER REACTIONS. Micic, O. I.; Cercek, B. (Paterson Labs., Manchester, Eng.). J. Phys. Chem.; 78: No. 3, 285-289(31 Jan 1974).

Rate constants and activation energies of several one-electron transfer reactions from organic anion radicals to neutral organic molecules in aqueous mixtures of methanol, ethanol, 1-propanol, glycerol, and urea were determined by the technique of pulse radiolysis. The solvent effect is more pronounced for slow than fast reactions. There is no regularity in the solvent effect on the reaction rates between species with the same functional groups. Kinetic parameters of the reaction change in a complicated manner with variations of the binary mixture content. The dependence cannot be explained by Marcus' theory for electron transfer reactions. Composition of the solvent closely surrounding the reacting species and their short-range interactions must be considered if a better understanding of the kinetics is to be achieved. (auth)

18152 ELECTRON PARAMAGNETIC RESONANCE AND ELECTRON-NUCLEAR DOUBLE RESONANCE LINE SHAPE STUDIES OF TRAPPED ELECTRONS IN γ-IRRADIATED DEUTERIUM-SUBSTITUTED 10 M SODIUM HYDROXIDE ALKALINE ICE GLASS. Bales, B. L. (California State Univ., Northridge, CA); Helbert, J.; Kevan, L. J. Phys. Chem.; 78: No. 3, 221-231(31 Jan 1974).

The EPR and ENDOR line widths and line shapes for the trapped electron produced by γ-irradiation in alkaline ice glasses at 77°K have been studied both theoretically and experimentally as a function of matrix deuteration. The theoretical model is based on the trapped electron (e_t^-) interacting equivalently with n nearest neighbor protons and deuterons. The interactions considered include (a) dipolar contributions between e_t^- and other radicals, (b) dipolar contributions between e_t^- and alkali metal nuclei, (c) dipolar interactions between e_t^- and nonnearest neighbor protons and deuterons, (d) dipolar interactions between e_t^- and nearest neighbor protons and deuterons, and (e) Fermi contact interactions with nearest neighbor protons and deuterons. The comparison of experimental and theoretical results allow us to set bounds on n and the Fermi contact coupling a, although unique values of a and n cannot be determined. It is also shown that the dipolar hyperfine coupling must be appreciable. Both theory and experiment show that the deviation of the line shape from Gaussian is a maximum near 80% deuteration. The experimental results also show that the line widths are dependent on sample preparation methods and that this dependence appears to be associated with the freezing rate at which the matrix is formed. A simple theoretical model suggests that at slower freezing rates there is a preference for OH over OD bond orientation toward e_t^-. (auth)

18153 KINETIC STUDIES OF PHOTOBLEACHING OF TRAPPED ELECTRONS IN PROTIATED AND DEUTERATED METHANOL AND ETHANOL GLASSES AT 77°K. Shida, T.; Imamura, M. (Inst. of Physical and Chemical Research, Saitama, Japan). J. Phys. Chem.; 78: No. 3, 232-234(31 Jan 1974).

Trapped electrons in γ-irradiated light and heavy methanol and ethanol at 77°K were photobleached with light of λ 450–600 nm and the decay was analyzed kinetically. The quantum yield of the bleaching was determined for both alcohols. The yield for the protiated alcohol was found to be 3 to 4 times as large as that for the deuterated alcohol. The remarkable difference in the yield is consistent with the assumption that most of the electrons disappear by a dissociative attachment to alcohol molecules. (auth)

18154 REDUCTION OF FERRICYTOCHROME c BY SOME FREE RADICAL AGENTS. Shafferman, A.; Stein, G. (Hebrew Univ., Jerusalem). Science; 183: No. 4123, 428-430(1 Feb 1974).

Fast pulse radiolysis and kinetic spectroscopy were used to rapidly generate a variety of free radicals in situ and study their reactions with ferricytochrome c in the time range 10^{-6} to 1 sec. The radicals included t-butanol, which is inert to ferricytochrome c; malate, lactate, and ethanol, which react with it relatively slowly but are completely utilized in reducing it to ferrocytochrome c; and hydrated electrons and hydrogen atoms, which react with it very rapidly but yield ferrocytochrome c only in part, showing intramolecular consecutive reactions and further attack on the ferrocytochrome c protein. From a detailed comparison between malate and hydrogen atoms it is argued that malate reacts directly and selectively with a specific part of the ferricytochrome c surface while hydrogen atoms react with other parts of the protein too, yielding radicals which in part transfer intramolecularly to yield ferrocytochrome c. (auth)

18155 INFLUENCE OF GAMMA-IRRADIATION ON THERMAL DECOMPOSITION OF CESIUM BROMATE. Mohanty, S. R.; Patnaik, S. K. (Utkal Univ., Bhubaneswar, India). Indian J. Chem.; 11: No. 9, 951(Sep 1973).

The kinetics of thermal decomposition of crystalline bromate, normal and irradiated with 50 Mrad ^{60}Co γ rays, was investigated over the temperature range 400 to 420°C. The substance decomposes mainly in two stages, acceleratory and decay, which follow the Prout-Tompkins relationship. Irradiation enhances the decomposition, but the energy of activation in either stage is not affected. (auth)

18156 CO- OR GRAFT POLYMERIZATION WITH THE HELP OF RADIOACTIVE RADIATIONS. Egginger, R. Chemiefasern Text.-Anwendungstech./Text. Ind.; 21: No. 11, 988-990(1971). (In German).

The refining of textile fibers by transverse crosslinking as well as by radiation–chemical grafting leads to products, some of which having considerably different properties compared to the original material. The possibilities of the property change using radioactive beams is not yet possible on a large technical scale for commercial use, however, this can be expected in the near future. (GE)

18157 RADIOLYSIS OF TBP SOLUTIONS IN CONTACT WITH NITRIC ACID. Barelko, E. V.; Solyanina, I. P. At. Energ. (USSR); 35: No. 4, 239-243(Oct 1973). (In Russian).

The radiolysis of TBP-synthine (synthetic mixture of hydrocarbons) solutions in contact with 3M HNO_3 at large dose values was studied for various oxygen concentrations. Chemical-radiative yields of the main products, DBP, MBP + H_3PO_4, and polymer were measured. The effect of these products on zirconium extraction for high concentrations of zirconium is examined. The cause of precipitate formation in the hydrolysis of such systems was determined. It is related to the formation of insoluble compounds of zirconium with DBP and MBP. This conclusion is confirmed by data from model experiments. (auth)

18158 FORMATION OF FREE RADICALS IN FROZEN AQUEOUS SOLUTIONS OF NUCLEIC ACIDS DERIVATIVES: SPECTROPHOTOMETRY AND ESR STUDIES. Lion, Y.; van de Vorst, A. (Univ., Liege). pp 525-533 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

The reaction of trapped electrons with nucleic acid bases was studied by electron spin resonance and spectrophotometry. Electrons were generated at 77°K by radiolysis of 8N NaOH and NaOD matrices. For adenine, guanine and thymine, the results showed that there is an intermediate step, possibly corresponding to the anion stage, in the formation of the hydrogen adduct radicals that were ultimately observed. The cytosine anion does not appear to protonate. It is shown that free radicals induced by photosensitization in DNA' constituents and more generally, in biomolecules, result also from a reaction between these substrates and electrons generated by biphotonic photoionization of the chromophore. Therefore, the similarity of the ESR spectra observed by radiolysis, photolysis; and photosensitization can be easily understood. (auth)

18159 ESR AS A TOOL FOR THE IDENTIFICATION OF IRRADIATED MATERIAL. Onderdelinden, D.; Strackee, L. (Rijksinstituut voor de Volksgesondheid, Bilthoven, Netherlands). (1973). vp.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Irradiation of solid material with ionizing radiation induces the formation of free radicals, which can be detected in principle by electron spin resonance. This technique therefore should yield an identification method for irradiated foodstuffs. The use of this method depends highly on the stability of the induced radicals. Some general aspects of the stability are reviewed. In wet material such as meat and vegetables the induced radicals disappear very rapidly. The stability of radicals induced by the irradiation of fats and fatty parts of meat was found to be higher. In all fats, irrespective of their origin, the ESP spectrum was found to be a symmetrical spectrum with an odd number of equidistant lines (a septet or a nonet with a splitting of about 16 gauss). These spectra were quite different from the spectra observed in irra-

diated fatty acids. A comparison of the fat spectra is made with the spectra of some irradiated triglycerides. Some experiments on irradiated bone samples are also described. The work performed thus far leads to the conclusion that ESR as a tool for the identification of irradiated foodstuffs can be used only in a very limited number of cases. (GE)

18160 RADIOINDUCED ALTERATIONS IN SOME NATURAL PIGMENTS OF SOME FOOD PRODUCTS. Snauwert, I. F. (Univ. Louvain, Belgium). (1973). vp.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Carotenoids, myoglobin, and chlorophylls are three widespread pigment groups of food. The influence of gamma radiation on those pigments is summarized. The influence of radurization on the carotenoids in Belgian shrimp and salmon species is discussed. The stability of those pigments in vivo is compared to the stability of β-carotene and canthaxanthin in model systems. The radio-induced alterations in myoglobins are also dealt with. Results on the influence of the presence of oxygen and/or phosphates on the formation of MetMb are reported. It was concluded that radio-pasteurization of meat may be employed without significant changes in the meat color characteristics, in contrast to heat pasteurization. The influence of gamma radiation on chlorophylls in peas is also considered. Chlorophyll b proved to be more stable than chlorophyll a. (GE)

18161 USE OF ELECTROPHORETIC TECHNIQUES TO IDENTIFY CERTAIN IRRADIATED FOODSTUFFS. van der Stichelen-Rogier, M. (Institut d'Hygiene et d'Epidemiologie, Brussels). (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Three electroporesis techniques have been tested for separating proteins extracted by means of a buffer solution from irradiated and non-irradiated samples of food. The techniques were vertical electrophoresis in starch gel, electrophoresis in polyacrylamide gel, and isoelectric focusing in polyacrylamide gel. The following foodstuffs were studied: beef (0.5 and 5 Mrad), cod fillet (1 Mrad), whole liquid egg (0.5 and 1 Mrad), shrimp (200 krad), cultivated mushroom (200 krad), white potato (15 krad) and onion (10 krad). For certain foodstuffs differences were observed in the separation of the extracts from irradiated samples and non-irradiated samples, particularly in the reduction or disappearance of certain groups of proteins. These results and the possibility of their practical use are discussed. (GE)

18162 POLYMERIZATION OF METHYL METHACRYLATE IN BAMBOO AND DATE PALM LEAVES BY GAMMA RADIATION. Mayahi, M. F. (Coll. of Science, Baghdad); Mofan, A. A. J. Indian Chem. Soc.; 50: No. 3, 219-220(Mar 1973).

Bamboo and date palm leaves, impregnated with methyl methacrylate (MMA) under atmospheric conditions, were irradiated with gamma radiation (2 Mrads) in the presence of air. Strong wood–polymer combinations were produced. The monomer-to-wood ratio is 15:20 by weight (42.8% monomer). This amount of MMA is just in excess of that needed for complete impregnation under atmospheric pressure. Date palm stem did not give any wood–plastic combination because of the inhibiting effect of lignin present in the stem. (auth)

18163 ELECTRON SPIN RESONANCE OF FREE RADICALS IN IRRADIATED SINGLE CRYSTALS OF NUCLEIC ACID CONSTITUENTS. Huettermann, J.; Mueller, A. (Univ., Ragensburg, Ger.). pp 517-522 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Essential results obtained in electron spin resonance studies of radioinduced radicals in nucleic acid bases, base analogues, nucleosides, and nucleotides are reviewed. Studies of polycrystalline samples of nucleic acids indicate that a radical transfer from the sugar moiety to the base groups occurs, radical stabilization taking place preferentially in the latter. The structures of known radicals are generally observed, resulting from either addition or loss of a hydrogen atom in a nucleic acid base or in a sugar moiety. The possible modes of formation of these radicals are briefly discussed. (INIS)

18164 GRAFTING OF DYES ONTO POLYMERS. Gulrajani, M. L. (Indian Inst. of Tech., New Delhi). Colourage; 20: No. 10, 27-30(May 1973).

Methods of grafting of dyes onto polymers are discussed in light of their use for the grafting of dyes. The methods described are (i) chain transfer reaction, (ii) radical attack on unsaturated polymer (iii) hydroperoxidation, (iv) redox systems and (v) radiation-induced graft copolymerization. In the uv- or γ-induced grafting, the molecule gains energy and enters excited states. This energy-rich molecule dissociated into reactive free radicals initiating the formation of block and graft copolymerization. If the breaking of the side chain bonds occurs a graft polymer is formed, while a block polymer results from the main chain fragment. A danger of homopolymerization is also indicated. The copolymerization process is most efficient when the polymer used is very sensitive to radiation. The possibility of grafting acidic and basic dyes onto silk, when it is exposed to γ rays in presence of the dye solution is also mentioned. (INIS)

18165 RADIATIONAL AND THERMAL CHANGES OF DODECANE-3% TBP–HNO_3. Nowak, Z. (Inst. of Nuclear Research, Warsaw). Nukleonika; 18: No. 10, 447-454(1973). (In Polish).

Radiolytic and thermal degradation of the n-dodecane–30% TBP–HNO_3 system were studied. On the basis of the yield of nitro and carbonyl compounds and the values of absorbance at 430 nm for the systems degraded at a various concentration of nitric acid, it is shown that marked differences exist between radiolytic and thermal degradation. (auth)

18166 SOLID-STATE STUDY OF THE POTASSIUM NITROSODISULFONATE RADICAL. Gangwer, T. E. (Wake Forest Univ., Winston-Salem, NC). J. Phys. Chem.; 78: No. 4, 375-379(14 Feb 1974).

The ESR and optical properties of the potassium nitrosodisulfonate radical trapped in the host potassium hydroxylaminedisulfonate crystal matrix are reported. Evidence is presented which indicates room temperature near-neighbor proton and low-temperature radical pair interactions occur in the x-irradiated crystals. These interactions are estimated to involve approximate distances of 2.3 and 6.4 Å, respectively. A broad absorption in the 360-nm range produced upon irradiation at 77°K is correlated with the radical pairs. A hydrogen-bonded configuration for the potassium hydroxylaminedisulfonate molecules in single crystals is proposed that correlates with the ESR results. (8 figures, 25 references) (auth)

18167 APPLICATION OF THE SEMICONTINUUM MODEL TO TEMPERATURE EFFECTS ON SOLVATED ELECTRON SPECTRA AND RELAXATION RATES OF DIPOLE ORIENTATION AROUND AN EXCESS ELECTRON IN LIQUID ALCOHOLS. Fueki, K.; Feng, D. F.; Kevan, L. (Wayne State Univ., Detroit). J. Phys. Chem.; 78: No. 4, 393-398(14 Feb 1974).

A method was developed for calculation of relaxation times for dipole orientation in liquid alcohols induced by localized excess electrons. A microscopic model was used, which utilizes quantities calculated from the Fueki, Feng, Kevan semicontinuum model of solvated and trapped electron energy levels. Calculated results for methanol, ethanol, and 1-propanol vs temperature agree well with experimental data. The semicontinuum model was also applied to the calculation of temperature effects on solvated electron spectra in liquid methanol, ethanol, and 1-propanol. The temperature dependence of the quasifree electron state, V_0, and of the effective dipole moment of molecules in the first solvation shell around the electron are considered for the first time. The calculated results account for about 70% of the observed temperature dependence. (6 figures) (auth)

18168 DIRECT IDENTIFICATION OF THE REACTIVE CHANNELS IN THE REACTIONS OF OXYGEN ATOMS AND HYDROXYL RADICALS WITH ACETYLENE AND METHYLACETYLENE. Kanofsky, J. R.; Lucas, D.; Pruss, F.; Gutman, D. (Illinois Inst. of Tech., Chicago). J. Phys. Chem.; 78: No. 4, 311-316(14 Feb 1974).

Reactions of O atoms and OH radicals with acetylene and methylacetylene were studied in high-intensity room-temperature crossed molecular beams. Products were detected using photoionization mass spectrometry. Major and minor observed reactive channels were assigned on the basis of the identity of the products observed and the magnitudes of the product ion signals. The numbers of major observed reactive channels are two for $O + C_2H_2$, one for $OH + C_2H_2$, seven for $O + C_3H_4$, and four for $OH + C_3H_4$. Details on reaction dynamics were obtained using deuterated compounds and are discussed. Evidence is presented for several types of mechanisms including abstraction, displacement, and addition followed by decomposition. (auth)

18169 DISPROPORTIONATION AND RECOMBINATION OF CYCLOPENTYL RADICALS. Tiliquin, B.; Allaert, J.; Claes, P. (Univ., Louvain, Belg.). J. Phys. Chem.; 78: No. 4, 462-463 (14 Feb 1974).

The ratio of rate constants for the disproportionation and recombination of cyclopentyl radicals was determined in γ-irradiated

solid cyclopentane. Yields of cyclopentane and dicyclopentyl were measured in molten and dissolved (110°K in O_2–propane) samples. Differences in G values were used to find a ratio of 3.05. (DLC)

18170 ROLE OF THE TRIPLET STATE IN THE PHOTOISOMERIZATION OF RETINAL ISOMERS. Rosenfeld, T.; Alchalel, A.; Ottolenghi, M. (Hebrew Univ., Jerusalem). J. Phys. Chem.; 78: No. 4, 336-341(14 Feb 1974).

The photoisomerization of 11-cis- and all-trans-retinals is investigated in aerated and deaerated solutions using direct singlet excitation as well as via sensitization from the triplet states of biacetyl and biphenyl. Triplet quantum yields are established for all-trans- and 11-cis-retinal using N_2-laser photolysis and pulse radiolysis. It is concluded that triplet energy transfer to 11-cis-retinal leads to isomerization with an efficiency of 15–17%, while no detectable isomerization can be induced by triplet transfer to the all-trans isomer. An analysis of the oxygen effects indicates that photosensitized isomerization precedes the formation of the fully thermalized retinal triplet. A mechanism in which isomerization is taking place from nonrelaxed vibronic triplet levels in competition with thermal deactivation is proposed. The new data are compared with available theoretical calculations and their relevance to the mechanism of isomerization induced by direct excitation is discussed. (auth)

18171 EFFECT OF IODINE AND OTHER SCAVENGERS ON THE γ RADIOLYSIS OF LIQUID PERFLUOROCYCLOHEXANE. Kennedy, G. A.; Hanrahan, R. J. (Univ. of Florida, Gainesville). J. Phys. Chem.; 78: No. 4, 360-365(14 Feb 1974).

The major radiolysis products of liquid F-cyclohexane are F-bicyclohexyl (G = 0.95), F-cyclohexylhexene, (G = 0.48), and F-cyclohexylhexane (G = 0.12). The production of these compounds is eliminated in the radiolysis of F-cyclohexane–iodine mixtures, and the following iodides are formed: F-cyclohexyl iodide (G = 3.1), F-hexenyl iodide (G = 0.8), F-hexyl iodide (G = 0.15), and a diiodide, $C_6F_{12}I_2$ (G = 0.12). It is concluded that the major end products from the radiolysis of F-cyclohexane are formed by free-radical reactions. Comparison of yields with and without added iodine indicates that the total G value for radical production is ca. 5.8. Yields estimated for particular radicals are as follows: G(F-cyclohexyl) = 3.0 ± 0.2; G(F-hexenyl) = 0.8 ± 0.2; G(F-hexyl) = 0.1 ± 0.05; and G(F-1,6-hexamethylene diradical) = 0.1 ± 0.05. Hydrogen iodide is apparently a poor radical scavenger in the F-cyclohexane system. Yields of the products expected from the scavenging process were found to be much lower than the radical yields estimated above. This low efficiency may be due to unfavorable polar effects in the transition state formed during the scavenging reaction. Bromine appears to be an efficient scavenger in irradiated F-cyclohexane, but the high reactivity of the bromine atoms produced may result in further reactions that complicate interpretation of the observed results. There appear to be two products with the formula $C_6F_{11}Br$, two products with the formula $C_6F_{12}Br_2$, and smaller amounts of several other C_1, C_2, and C_6 bromides. (4 tables, 5 figures) (auth)

18172 EFFECT OF IODINE AS A RADICAL SCAVENGER IN THE γ RADIOLYSIS OF LIQUID-PHASE CYCLOHEXANE–PERFLUOROCYCLOHEXANE SOLUTIONS. Kennedy, G. A.; Hanrahan, R. J. (Univ. of Florida, Gainesville). J. Phys. Chem.; 78: No. 4, 366-371(14 Feb 1974).

An investigation was made of the effects of I_2 as a radical scavenger in the γ radiolysis of liquid-phase c-C_6H_{12}–c-C_6F_{12} mixture at 65°C. Both iodine consumption (with added I_2) and iodine production (with added HI) appear to give reliable counting over most of the concentration range. The total radical yields were found to be about 6.0 for both of the pure compounds and to maximize at about 9.0 for solutions containing 30 electron % c-C_6F_{12}. With respect to the hydrocarbon products, both the qualitative and quantitative effects of added I_2 agree with simple expectations; the disproportionation/combination products (cyclohexene and dicyclohexyl) from cyclohexyl radicals are sharply reduced, and a substantial yield of c-$C_6H_{11}I$ is formed, showing a maximum yield of 7.2 which is nearly constant from 10 to 60 electron % c-C_6F_{12}. The H_2 yield, which is strongly depressed by the fluorocarbon, shows little further effect of the added I_2. Remarkably, the yield of c-$C_6F_{11}H$ is essentially unaffected by added I_2, in spite of the fact that I_2 is a good scavenger of c-C_6F_{11} radicals in pure C-C_6F_{12}. It appears that the (thermal) c-C_6F_{11} radical is not a precursor of c-$C_6F_{11}H$ in the irradiated mixtures. This result apparently requires reevaluation of previous suggestions concerning the mechanism of C–F bond rupture in irradiated fluorocarbon–hydrocarbon mixtures. Additional photolytic experiments on solutions containing HI (as a source of H atoms) and triphenylamine (as a source of photoelectrons) suggest, respectively, that H atoms are not involved, and that electrons or negative ions are involved, in C–F bond rupture. (auth)

18173 FREE RADICALS IN AN ADAMANTANE MATRIX. VIII. EPR and INDO Study of the Benzyl, Anilino, and Phenoxy Radicals and Their Fluorinated Derivatives. Lloyd, R. V.; Wood, D. E. (Univ. of Connecticut, Storrs). J. Amer. Chem. Soc.; 96: No. 3, 659-665(6 Feb 1974).

The effect of the different exo groups (–CH_2, –NH, or –O) on the structure and EPR parameters of the radicals was studied and trends in the fluorine and proton hfs were correlated with structural changes in the series. Fully optimized geometries calculated by INDO for the parent radicals show that in going from benzyl to phenoxy the benzene ring, which is a distorted hexagon in benzyl, becomes increasingly more symmetric, due to the increasing importance of an ionic resonance form which places an electron pair on the exo atom (C, N, or O) and an unpaired electron on the positively charged ring. EPR parameters were obtained of all the monofluoro derivatives of benzyl, anilino, and phenoxy, including those previously unknown. Trends in the various hyperfine splittings show that the overall spin density in the ring increases from benzyl to phenoxy, thus supporting the prediction of increasing importance of an ionic form. The existence of the "ortho" effect in benzyl and anilino but not in phenoxy radicals was confirmed both experimentally and theoretically whereby the fluorine hfs in o-fluoro derivatives is less than would normally be expected. Results suggest that the effect is due to a bonding interaction between the ortho fluorine and a proton on the exo atom. (auth)

18174 ELECTRON SPIN RESONANCE SPECTRA OF RADICALS RELATED TO THE INTERMEDIATES IN THE OXIDATION OF ASCORBIC ACID. Substituted 2,3,4-Trioxopyrrolidine Radical Anions. Kirino, Y.; Southwick, P. L.; Schuler, R. H. (Carnegie–Mellon Univ., Pittsburgh). J. Amer. Chem. Soc.; 96: No. 3, 673-677(6 Feb 1974).

Four substituted 2,3,4-trioxopyrrolidine radical anions were prepared by the oxidative debromination and denitration of the corresponding 4-bromo- and 4-nitro-3-hydroxy-3-pyrrolin-2-ones. In situ radiolysis–ESR methods were used to observe the radicals from the nitro derivatives whereas the bromo derivatives readily give the radicals chemically either in aqueous solution or in basic DMSO. The radicals substituted on the nitrogen are extremely unreactive and are observable for a period of at least 24 h after sample preparation. All four radicals are very similar in that they have nitrogen hyperfine constants of ~2 G. A methyl proton hyperfine constant of 3.35 G is observed for the N-methyl derivative showing that there is an electron spin density of ~0.11 on the nitrogen atom. The very small hyperfine constants for the protons at the C_5 position (0.2 – 0.5 G) are explained as the result of almost complete cancellation of the effects of spin density on the nitrogen and C_4 carbon atoms. Comparison of the parameters observed in water and in DMSO shows that in the latter case an appreciably greater amount of spin density has been transferred to the carbonyl oxygen atoms. Results substantiate the previous suggestion that in the similar radicals derived from α-hydroxytetronic and ascorbic acids there is a spin density of 0.03 on the heterocyclic oxygen atom. (auth)

18175 STRUCTURAL CONTROL IN THE γ-RADIATION-INITIATED POLYMERIZATION OF 1-VINYLURACIL. Kaye, H.; Chang, S. H. (Texas A and M Univ., College Station). Macromolecules; 5: No. 4, 397-401(1972).

Preparation by radiochemical polymerization of noncyclopolymerized poly(1-vinyluracil) is described. Polymerization at low temperature and high monomer concentration in the solid state, of negatively charged monomers, of monomers containing bulky substituents took place. (tr-auth)

18176 STUDY INTO THE IDENTIFICATION OF IRRADIATION GROUND PAPRIKA. Beczner, J. (Kozponti Elelmiszeripari Kutato Intezet, Budapest); Farkas, J.; Kiss, I.; Watterich, A.; Buda, B. (1973). vp.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Several methods for the demonstration of irradiation in ground paprika were tested. In carbonyl compounds extracted by steam distillation unambiguous changes, which might have served as a basis for detecting irradiation, were not observed. Derivatography did not prove suitable either. On the basis of the size of ESR signal, the control sample and the irradiated one could be distinguished 2 to 3 weeks after irradiation. After a longer storage period, the size of the signal is irrelevant. Further study of the shape of the ESR signals may yield valuable information in experiments on the demonstration of irradiation. (GE)

18177 RECENT INVESTIGATIONS IN RADIATION CHEMISTRY. Spitsin, V. I. (Inst. of Physical Chemistry, Moscow). Isotopenpraxis; 9: No. 9, 301-309(Sep 1973). (In German).

Results obtained in the last two or three years in the study of the properties of solvated and capture electrons, radiation chemistry of solids, studies in the area of radiation catalysis, and radiation graft polymerization are briefly reviewed. (45 references) (JSR)

18178 RADIOLYSIS OF ETHYLENE GLYCOL IN AQUEOUS SOLUTION IN THE PRESENCE OF HYDROGEN PEROXIDE. Vetrov, V. S.; Kalyazin, E. P.; Petryaev, E. P. (Inst. of Nuclear Engineering, Minsk). Dokl. Akad. Nauk BSSR; 17: No. 9, 824-825 (Sep 1973). (In Russian).

It was shown that a chain process of the formation of glycol aldehyde is possible in this system. The concentration of ethylene glycol shows a substantial effect on the development of the chain process. (tr-auth)

18179 RADIATION GRAFTING OF VINYL FLUORIDE TO POLY(VINYL CHLORIDE) FROM THE VAPOR PHASE. Musakhanova, S. M.; Usmanov, Kh. U.; Yul'chibaeva, A. A.; Asamov, M. K. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 6, 41-42(1973). (In Russian).

The radiation grafting of vinyl fluoride to powdered polyvinyl chloride from the vapor phase is discussed. The grafting was carried out at dose outputs of γ radiation of 8, 18, and 70 r/sec. The quantity of grafted polyvinyl chloride increases with the increase of the duration of the irradiation, which is explained by the continuous course of the grafting process with time, and with increase of the dose output; which is explained by the acceleration of the initiation. Thermochemical curves showed that the initial powdered polyvinyl chloride has a lower fluidity temperature than the grafted copolymer and the irradiated polyvinyl chloride. (JSR)

18180 CALCULATION OF RADIATION-CHEMICAL YIELD UNDER FLOW TRANSIENT TEMPERATURE CONDITIONS. Kalyazin, E. P.; Kovaleva, E. P.; Petruaev, E. P. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Khim. Navuk; No. 1, 19-20(1972). (In Russian).

Principles were reported of the calculation of the radiation chemical yield under the condition that the individual elements of the loop have different temperatures, specifically the irradiator heats or cools, but the other points work at room temperature. (tr-auth)

18181 X-RAY FLASH DEVICE FOR PULSE-RADIOLYTIC INVESTIGATIONS. Hinsch, H.; Scheel, H. E.; Niemann, E. G. (Gesellschaft fuer Strahlen- und Umweltforchung mbH, Hanover). (1973). vp. (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

High-voltage pulses are produced by the discharging of charged condensers in series over a triggered spark gap (voltage doubler according to MARX) and are conducted over a second spark gap on the (tubular anode co-axial surrounding) ring cathode of the x-ray tubes (evacuated to 10^{-5} Torr). At a charging voltage of 150 kV, an energy of 1,125 Joules is stored. The anode surrounding the sample to be irradiated (with a 200-μ tungsten coated aluminium tube) has almost 50% bremsstrahlung transmission. From experiments, no connection could be found between the cathode form and x-ray pulse dose. The half-width of the pulse is on overage 0.2 μsec, the reproducible dose obtained, 400 R per pulse, the average energy of the x-ray quanta, 44 keV, and the half-width of the axial dose distribution is 45 mm. The apparatus enables the determination of the reaction courses and changes in concentration of radiolytic products in the range of microseconds. (GE)

18182 CHEMICAL REACTIONS AND EFFECTS OF IONS OF HIGH ENERGY. Wolf, G. K. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 3, 14-17(Nov 1973). (In German).

The generation of ions of high energy and their application in physical chemistry and materials research, in organic chemistry, and in nuclear and radiation chemistry are dealt with. (GE)

18183 RADIOLYSIS OF POLYISOPRENE WITH HIGH CONTENT OF 1,2, AND 3,4 UNITS. Katzer, H. Munich; Technische Univ. (1971). 88p. (In German).

Thesis.

The radiolysis of polyisoprene with a high amount of 1,2 and 3,4 units, with the double bond in the side chains, was investigated. In order to ascertain the changes, the increase in the molecular weight within the Pregel range, the sol-gel fractions within the gel range, the reduction of double bonds, the formation of dienes, the structure and concentration of the radicals, as well as the formation of H_2 and CH_4 have been determined. The results of the sol-gel measurements in relation to the dose have shown that linking occurs via a chain reaction. For the formation of the species starting the linking process, a mean G(S)-value of 2.5 has been found, with the reaction chain leading to four cross-linkages on the average. The G(S)-values and the length of the reaction chains are slightly dependent on the molecular weight. In order to be able to determine the role of double bonds in the formation of cross-linkages, the reduction of double bonds has been determined by ir spectroscopy. Furthermore, the influence of dose rate, irradiation temperature, and various additives has been investigated. ESR spectra were measured and the diene bonds were measured by uv spectroscopy. From the results it is seen that the process of cross linking in polyisoprenes with a high amount of 1,2 and 3,4 units proceeds via a chain reaction, whereas the crosslinking in 1,4 polyisoprenes occurs in the conventional manner, i.e. by one ionization or excitation for every crosslinking event. (GE)

18184 ENRICHMENT, SEPARATION, AND GAS-CHROMATOGRAPHIC AND MASS-SPECTROMETRIC ANALYSES OF FISSION PRODUCTS FROM IRRADIATED OR HEATED FATS, OILS, AND TEST SUBSTANCES. Beck, B. (Technische Univ., Munich). (1973). vp. (In German).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Tripalmitate, tristearate, trioleate, oleic acid methyl ester, linoleic acid methyl ester, lauric acid, lard, coconut butter, sunflower oil, and olive oil were irradiated at 0.5-6 Mrad,or heated up to 174°C for 24 hr. The fission products were fractionally distilled with silica gel according to polarity into elutropic series. Subsequent identification and quantitative determination were done by gas chromatography and mass spectrometry. Approximately 28 hydrocarbons and 24 oxygen compounds are dealt with, the typical substances being described individually as regards their identification and quantitative distribution. (GE)

18185 STUDY OF THE MACROMOLECULAR FRACTION OF IRRADIATED STARCH: FIRST RESULTS OF ENZYMATIC AND CHROMATOGRAPHIC INVESTIGATIONS. Tollier, M. T.; Guilbot, A. (Institut National de Recherches Agronomiques, Massy, France). (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

During previous experiments the presence of modified andro-hydroglucose units in the macromolecular fraction of irradiated starch has been observed, and after acid hydrolysis, several by-products were isolated, some of which bore the characteristics of deoxysugars. The present project studied the macromolecular fraction of normal and waxy irradiated maize starch granules by means of the action of specific enzymes of $\alpha \cdot 1\text{-}4$, $\alpha \cdot 1\text{-}6$ glucanes and column chromatography. The first results related to the developments in the elution diagrams of the macromolecular chains, obtained by molecular adsorption on Sephadex G 50 gel, both before and after irradiation of the starch and both with and without previous enzyme action. The enzymes used were β amylase, pullulanase and glucamylase. Certain preliminary deductions could be made on the influence of irradiation on the length of macromolecular chains and the distribution of modified andro-hydroglucose units in such macromolecular populations. (GE)

18186 IDENTIFICATION OF CARBOHYDRATE-CONTAINING FOODSTUFFS BY ANALYSIS OF RADIATION SPECIFIC SUBSTANCES. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). (1973). vp. (In German).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

The radiolysis of carbohydrates yields deoxycarbonyl compounds, 1,4-pyrones, and unusual polyhydroxy carbonic acids, which can be identified by thin layer and gas chromatography. Some of these compounds are radiation specific. The amounts in which they are produced depend on irradiation dose as well as on the physical properties and chemical composition of the food. As test objects we used mainly wheat flour. Detection of irradiation treatments with doses of 500 krad and above is possible after concentration of the radioinduced substances with the aid of liquid-liquid extraction, dialysis and ion-exchange methods. (GE)

18187 CHEMICAL AND BIOLOGICAL TECHNIQUES FOR IDENTIFYING IRRADIATED FOODS AND FOOD CONSTITUENTS-CARBONYLS AND 2-DEOXYGLUCONIC ACID. Schubert, J.; Esterbauer, H. (Univ. of Pittsburgh). (1973). vp.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

New microbiological and chemical procedures are described for the detection, concentration, and identification of compounds produced in irradiated foods. The microbiological method employs an

equation, by which inhibition of cell growth is expressed in a simple, economic, and consistent manner for identification of different classes of growth inhibitors using a single growth index, namely, concentration of substance at which time needed for log phase cells to double is ten times the controls. The chemical procedure permits carbonyl compounds to be spectrophotometrically determined in the presence of carbohydrates without prior separation. The G(carbonyl) yields have been measured in irradiated hexoses and disaccharide solutions in the presence and absence of OH scavengers (KI and formate) and e_{aq} scavengers (N_2O). It has been demonstrated that the cytotoxic carbonyls produced upon carbohydrate irradiation are dicarbonyl sugars which convert to α, β-unsaturated carbonyl sugars by enolization or dehydration upon heating. Carbonyl yields in various irradiated foods are reported (e.g., strawberries: G = 2.2 and beef, G = 0.8). Both the carbonyl and microbiological techniques are uniquely applicable to the identification of non-volative compounds produced in irradiated foods. By anion exchange, we can rapidly separate enolizable carbonyls and 2-deoxygluconic acid from neutral sugars and obtain concentration factors of 50-fold and greater, thus enabling us to differentiate irradiated from non-irradiated foods at low radiation doses (approximately 1 Krad). (GE)

18188 OPTICAL ABSORPTION SPECTRUM OF THE SOLVATED ELECTRON IN ETHERS AND IN BINARY LIQUID SYSTEMS. Dorfman, L. M.; Jou, F. Y. Contract AT(11-1)-1763. pp 447-459 of Electrons in Fluids. Jortner, J. (ed.). Berlin; Springer-Verlag (1973).

Optical properties of the solvated electron produced by pulse radiolysis in ethers and binary liquids provide new evidence concerning the structure and properties of the solvated electron. A range of behavior is observed in mixed solvent systems which requires that more attention be paid to the short-range solvent structure. (9 figures) (auth)

18189 PULSE RADIOLYSIS OF HEXAMETHYLPHOSPHORIC TRIAMIDE. Kouikes-Pujo, A. M. (Cen de Saclay, Gif-sur-Yvette, France); Gilles, L.; Lesigne, B.; Sutton, J.; Gal, J. Y. J. Chem. Soc., Chem. Commun.; No. 2, 71-72(16 Jan 1974).

The pulse radiolysis of pure or a NaBr solution of hexamethylphosphoric triamide (HMPT) (saturated either with Ar or N_2O) suggests that the transient with a maximum absorption at 600 nm is due to a bromine atom charge-transfer complex giving an ionization potential for HMPT of 8.1 eV and also that the uv absorption is associated with an excited state of HMPT. (auth)

18190 PRIMARY YIELDS IN THE γ-RADIOLYSIS OF GASEOUS ALIPHATIC AMINES. Sami, M. A.; Smithies, D. (Univ. of Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 70: No. 1, 51-57(1974).

Yields of H_2 and CH_4 from methyl-, dimethyl-, trimethyl- and ethylamine vapors γ-irradiated at room temperature were measured. The effects of dose, pressure, and electron and free radical scavengers on these yields have been studied. From the decreases in $G(H_2)$ in the presence of scavengers values for G_{H_2}, G_e, G_H and relative rate constants for some reactions of H atoms have been calculated. Except for methylamine the values of G_e obtained in this way are lower than those obtained from measurements of the energy of ion pair formation, W. Ethylenediamine is a product from radiolysis of methylamine, but dimethylhydrazine is not. (auth)

18191 ELECTRON SPIN RESONANCE STUDIES OF ELEMENTARY PROCESSES IN RADIATION- AND PHOTO-CHEMISTRY. XII. Fluorinated Carboxylic Acids at Cryogenic Temperatures. Ayscough, P. B.; Mach, K. (Univ. of Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 70: No. 1, 118-129(1974).

Some information concerning the mechanism of the radiolysis of perfluorinated carboxylic acids is presented from an examination of the ESR spectra of radicals trapped in polycrystalline samples of the acids between 77 and 300°K. Three types of radicals were identified in γ-irradiated samples of RCF_2COOH (R = F, CF_3, CF_3CF_2, C_8H_{13}, CF_2COOH, CF_2CF_2COOH). These are (1) parent radical anions $RCF_2\dot{C}OOH^-$, (2) primary fluoralkyl radicals RCF_2, and (3) secondary radicals $R\dot{C}FCOOH$. The radical anions lose F^- on thermal annealing to yield additional $R\dot{C}FCOOH$ radicals, but when samples containing $RCF_2\dot{C}OOH^-$ are uv-irradiated at 77°K these species disappear without the appearance of any identifiable radical product, as do the corresponding species in nonfluorinated carboxylic acids. The $R\dot{C}F_2$ radicals are believed to originate from the cationic species formed in the initial ionization following proton transfer and elimination of CO_2. (auth)

18192 POLYMERISATION PROCESS FOR ACRYLONITRILE. Murgulescu, I. G.; Oncescu, T. O.; Vlagiu, I. I. (to Centrul de Chimie Fizica). British Patent 1,337,109. 14 Nov 1973. Filed Date 26 Feb 1970. 2p.

An improved method is described for the production of a polyacrylonitrile solution from which fibers may be spun. Earlier methods for polymerizing acrylonitrile have required the use of catalysts in order to obtain satisfactory spinning solutions, and the polymer thus produced incorporates traces of the catalyst, which is not only expensive, but also promotes degradation of the polymer when exposed to the weather; in addition the process requires many hours for its completion. The method described uses a mixture of acrylonitrile with dimethyl sulfoxide, which is heated to about 50°C and subjected to γ- or x-ray irradiation. Vinylic monomers or organic acids may be included to fix dyestuffs. Polymerization times are short, a 6-hr reaction producing, for example, 65% by weight of polymer. The amount of dimethyl sulfoxide should preferably exceed that of acrylonitrile in a ratio of about 7 to 1. The process is characterized by its simplicity of manipulation and its ability to be incorporated into a flow system. A manganese oxalic acid complex may be incorporated in the reaction mixture to introduce carboxylic groups and to stabilize the spinning solution, and if a small amount of hydrazine sulfate is present the acrylonitrile fibers show a higher degree of white matte, while addition of vinyl toluene during the reaction results in fibers with improved physical and mechanical properties. Examples of application are given. (UK)

18193 ULTRAVIOLET AND γ-RAY-INDUCED REACTIONS OF NUCLEIC ACID CONSTITUENTS. Reactions of Purines With Amines. Salomon, J.; Elad, D. (Weizmann Inst. of Science, Rehovoth, Israel). Photochem. Photobiol.; 19: No. 1, 21-27(Jan 1974).

Photochemical and γ-ray induced reactions of purines with amines are described which lead to the appropriate 8-substituted purines. The photoproducts were obtained in yields of up to 100% by the use of a variety of photosensitizers, including peroxides. A free radical mechanism is proposed for these reactions. It is suggested that such reactions may be relevant to the problem of the nature DNA-protein cross-links induced by ultraviolet radiation. (auth)

18194 DETERMINATION OF RATE CONSTANTS FOR THE REACTIONS OF OH WITH PROPYLENE AND ETHYLENE BY A PULSED PHOTOLYSIS-RESONANCE FLUORESCENCE METHOD. Stuhl, F. (Univ., Bochum, Ger.). (1973). vp.

From 11th international symposium on free radicals; Berchtesgaden, Germany (4 Sep 1973).

Absolute rate constants for the reactions of OH radicals with CH_3CHCH_2, CD_3CHCH_2, CH_3CDCD_2, CD_3CDCD_2, and CH_2CH_2 were determined at 298°K. Hydroxyl radicals were generated in the pulsed vacuum-uv photolysis of H_2O. Decays of OH were monitored by resonance fluorescence in an excess of hydrocarbons. The rate constants for the reactions with propylene and ethylene were determined to be 1.45 ($\pm$0.22) $\times 10^{-11}$ and 3 ($\pm$1) $\times 10^{-12}$ cm^3 $molecule^{-1}$ sec^{-1}, respectively. The kinetic isotope effect for deuterated propylene was found to be small, thus supporting the proposed addition mechanism. (GE)

18195 IMPORTANCE OF DOSIMETRY OF INTENSE RADIATION BEAMS IN RADIATION-CHEMICAL TECHNOLOGY. Breger, A. Kh. pp 7-11 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The importance of work on the dosimetry of intense radiation beams in radiation chemical industry is indicated. The accuracy of the methods of experimental determination of the absorbed dose plays a basic role in the increase of the efficiency of irradiation installations. It was shown that the increase of the sensitivity and accuracy of the methods for the determination of the absorbed dose leads to improved economic efficiency of the radiation chemical industry. (tr-auth)

18196 CHARACTERISTICS OF COMMERCIAL DOSIMETRY DURING ACCOMPLISHMENT OF RADIATION PROCESSES ON AN INDUSTRIAL SCALE. Osipov, V. B. pp 12-18 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.) Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The characteristics of commercial dosimetry during control of different radiation chemical processes are analyzed. The use of absorbed dose indicators of domestic and foreign manufacture is examined. The distinguishing characteristics of commercial dosimetry of γ ray installations and electron beams are shown,

and the requirements on developed dosimetric systems are formulated. (tr-auth)

18197 DOSIMETRY AT THE PILOT PLANT FOR RADIATION MODIFICATION OF POLYETHYLENE PRODUCED AT THE BROVARSKII PLASTIC PLANT. P'yankov, G. N.; Zhikharev, V. S.; Bordikova, A. N.; Kabakchi, A. M. pp 103-106 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The commercial dosimetry of the radiation modification of polyethylene films and pipes using colored cellophane and cellulose diacetate dosimeters was developed. The optimum conditions for the irradiation guaranteeing the uniformity of the absorbed dose field within ± 5% were selected. (tr-auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 19675 and 19779.

18198 APPLICATION OF RADIOACTIVE ISOTOPES IN THE CHEMICAL INDUSTRY. Trajkov, I. Khim. Ind. (Sofia); 44: No. 5, 220-224(1972). (In Bulgarian).

A review is made on the practical application of radioisotope devices, labelled atoms, radioinduced chemical reactions, and nuclear methods of analysis. The operating principles, operational data, and advantages of radioisotope level gauges, densimeters, thickness gauge, charging scales, and different counters of packings are described. Numerical data of their production in different countries and in Bulgaria are given. There has been mentioned the following applications of radiation chemistry: sulfonic-acid chlorination of alkanes; radiation synthesis of tetrachloralkanes; radiation vulcanization of rubber; radiation polymerization of monomers; radiation modification of polymers, natural and synthetic fibres; production of wood--plastics and concrete--polymers. The use of activation analysis and x-ray-induced fluorescence has been indicated. (auth)

Hot-Atom Chemistry

Refer also to abstract 18144.

18199 REACTIONS OF TELLURIUM FISSION PRODUCTS WITH CARBON MONOXIDE. Strickert, R. G.; Amiel, S.; Wahl, A. C. (Washington Univ., St. Louis). Inorg. Nucl. Chem. Lett.; 10: No. 2, 129-135(Feb 1974).

Reactions of recoiling fission products with gases to form volatile compounds offer the means for rapidly separating short-lived fission products. The reactions of recoiling ^{31}S and ^{83}Se with CO suggested that tellurium fission products might also react with CO, to form TeCO. Experimental details and results are presented, indicating that a volatile tellurium carbonyl, probably TeCO, is formed. Information is also presented about the reactions of individual isotopes of tellurium with CO. (UK)

18200 HALF-LIFE VARIATION AS A TECHNIQUE FOR THE STUDY OF RECOIL ATOMS IN SITU. Dema, J.; Harbottle, G. (Brookhaven National Lab., Upton, NY). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

A differential counting technique was used to study the half-life variation of the in-situ ^{64}Cu in neutron-irradiated copper phthalocyanine. The results of Auric and Vargas reported at the Brookhaven (Sixth) Hot Atom Meeting could not be confirmed. Using very carefully pretreated and measured samples, no deviations in half-life of recoil ^{64}Cu and lattice-annealed ^{64}Cu, within experimental error, could be found. The authors come to the conclusion that measurement of half-life variations is not a useful technique for the investigation of the recoil atom in situ. (GE)

18201 HOT ATOM ISOTOPE EFFECT IN D-ABSTRACTION FROM ALKANES. Malcolme-Lawes, D. J. (Univ. of Kent, Canterbury, Eng.). J. Chem. Soc., Chem. Commun.; No. 1, 7-8(2 Jan 1974).

A major difference between the hard-sphere D-abstraction excitation functions for hot H and T atoms reacting with RD has been observed, suggesting that certain extrapolations between the H and T systems may be invalid. (auth)

18202 RAPID SEPARATION OF RECOIL PRODUCTS IN THE GASEOUS PHASE. Baechmann, K.; Boegl, W.; Buettner, K. (Technische Univ., Darmstadt, Ger.). Z. Anal. Chem.; 267: No. 4, 274-277(Dec 1973). (In German).

Experiments are described in which recoil products are separated fast and selectively. The aim of these investigations is an identification of short-lived nuclides, either for the study of nuclear reactions or for the study of decay properties of new products. The recoil products were provided by a ^{252}Cf source. The transportation zone and the identification zone could be heated to different temperatures. Using N_2 as carrier gas it was possible to separate Te selectively under certain experimental conditions. When Cl_2 was added, Sb, Tc, Nb, Mo, Zr, Ru and Sn were transported. Transport output was determined in dependence of temperature and composition of the gas. (GE)

18203 SEPARATION OF THE RECOIL PRODUCTS OF ^{224}Ra AND ^{252}Cf SOURCES BY FORMATION OF ALKYL COMPOUNDS. Hoffman, P.; Baechmann, K.; Klenk, H.; Trautmann, W.; Lieser, K. H. (Technische Univ., Darmstadt, Germany). Z. Anal. Chem.; 267: No. 4, 277-280(Dec 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Ger. (2 Apr 1973).

A new method for the separation of recoil atoms produced by the decay of ^{224}Ra was developed by applying alkyl radicals. Argon was used as carrier gas and the transported alkyl compounds thermally decomposed in front of a Ge(Li) detector. Under the experimental conditions ^{212}Pb and ^{212}Bi could be transported with high yields whereas transport of ^{208}Tl could not be proved. There was no interference of the measurements by ^{220}Rn. Using ^{252}Cf as a source for fission products the recoil atoms were stopped in argon (about 4 atm). The thermalized recoil products were mixed with alkyl radicals and the possibly formed alkyl compounds were thermally decomposed in front of a detector. In the experiments with pure argon as inert gas high yields of iodine were found. (GE)

18204 CHEMICAL STATES OF SULFUR-35 FORMED BY THE $^{35}Cl(n,p)^{35}S$ PROCESS IN POTASSIUM CHLORIDE. Giulianelli, J. L.; Willard, J. E. (Univ. of Wisconsin, Madison). J. Phys. Chem.; 78: No. 4, 372-374(14 Feb 1974).

Using neutron-irradiated KCl crystals pretreated to maximize the "labile" fraction of ^{35}S formed by the $^{37}Cl(n,p)^{35}S$ process, the chemical reactions of this fraction upon dissolution were examined using different scavengers, reductants, and carriers. This 85% component is oxidized to $^{35}SO_3^{2-}$ when dissolved in carrier-free aqueous NaOH and appears as $^{35}S^{2-}$ when only S^{2-} carrier is present. When only SO_3^{2-} carrier is present, it appears in three fractions: 20% $S_2O_3^{2-}$, 50% S^{2-}, and 15% SO_3^{2-}, indicating the presence of (1) S_3^-, (2) a species reduced by SO_3^{2-}, and (3) a species which exchanges with SO_3^{2-}. Tests in the presence of CN^- and allyl alcohol are consistent with these findings. Experiments on the effect of temperature of dissolution of the KCl on the distribution of the ^{35}S activity and on the production of S_3^- in water by photolysis of OCS are also described. (4 tables) (auth)

18205 RECOIL TRITIUM REACTIONS WITH METHYLCYCLOHEXENE. A Test of the Assumption of Energy Randomization Prior to Unimolecular Decomposition. Fee, D. C.; Markowitz, S. S. (Univ. of California, Berkeley). J. Phys. Chem.; 78: No. 4, 354-360(14 Feb 1974).

The reactions of recoil tritium atoms with the three methylcyclohexene isomers were studied in the gas phase at 135°C. T was produced by $^3He(n,p)T$. Recoil tritium atom abstraction, addition, or T-for-H substitution reactions accounted for 90% of the gas-phase products. Following activation by T-for-H substitution, the unimolecular decomposition of 4-methylcyclohexene-t (to give propylene-t or butadiene-t) and the unimolecular decomposition of 3-methylcyclohexene-t (to give ethylene-t or 1,3-pentadiene-t) was established from the pressure dependence of the product yield in the 300-1200-torr pressure range. The apparent rate constants for these unimolecular decomposition processes were determined as 1×10^7 and 3×10^6 sec^{-1}, respectively. The rate constants for the unimolecular decomposition of cyclohexene-1-t and cyclohexene-3-t (formed by T-for-methyl substitution on 1-methylcyclohexene and 3-methylcyclohexene, respectively) were nearly equivalent. In addition, the average energy of excitation following T-for-methyl substitution is the same in cyclohexene-1-t and cyclohexene-3-t, namely, 6.0 to 6.5 eV. It was concluded that the RRKM (Rice, Ramsperger, Kassel, and Marcus) assumption of energy randomization prior to unimolecular decomposition is valid for the recoil tritium initiated unimolecular decomposition of cyclohexene. (44 references) (auth)

18206 RECOIL TRITIUM REACTIONS WITH CYCLOHEXENE AND ALKENES. Determination of Rate Parameters. Fee, D. C.; Markowitz, S. S. (Univ. of California, Berkeley). J. Phys. Chem.; 78: No. 4, 347-354(14 Feb 1974).

Kinetic rate parameters can be determined from recoil tritium

reaction studies although the energy distribution of the reacting tritium atoms is not known. T is produced by $^3He(n,p)T$. Recoil T-for-H substitution on cyclohexene gives excited cyclohexene-t molecules. The dependence of product yield on pressure (in the 300–1500 torr pressure range) showed that the excited cyclohexene-t molecules decomposed unimolecularly to give ethylene-t and butadiene-t with an apparent rate constant (at 135°) of 5×10^6 s^{-1}. The s parameter in the RRK (Rice, Ramsperger, and Kassel) treatment of the unimolecular decomposition of cyclohexene was determined as s = 24. Similarly, the pressure dependence of product yield showed that cyclohexyl-t radicals which are formed by recoil T atom addition to cyclohexene decomposed unimolecularly to give n-hexene-t, 1-butene-t, and methane-t with rate constant 8×10^3, 3×10^4, and 5×10^3 s^{-1}, respectively. The relative rate of abstraction vs addition of radicals in alkenes was determined from the scavenger dependence of the yields of products with a radical precursor. (40 references) (auth)

18207 MECHANISM OF THERMAL ANNEALING REACTIONS IN COPPER PHTALOCYANINE. Auric, P.; Vargas, J. L. (CEN, Grenoble, France). (1973). vp.

From seventh international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

The influence of gases and crystalline phase preparations on the isochronal thermal annealing reactions of (n,γ) recoil fragments in copper phtalocyanine was investigated in order to have a better understanding of the mechanism of annealing in neutral complexes of transition elements. Complementary to the aforementioned studies, measurements of the variation of orbital electron capture decay rate in ^{64}Cu were used to determine the chemical state of atoms that have undergone a thermal neutron capture in copper phtalocyanine. This chemical state is predominantly a Cu^0 one. From these results and various authors' conductivity investigations, a mechanism of annealing reactions in (n,γ) irradiated copper phtalocyanine is suggested. (GE)

18208 CARBON-14 DECAY, RETENTION IN RELATION TO MOLECULAR STRUCTURE. Raadschelders-Buijze, C.; van Zanten, B. (Vrije Universiteit, Amsterdam). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

The radioactive decay of ^{14}C has been followed in simple, double-labelled hydrocarbons (derived from acetylene-1,2-^{14}C). As a result of this process the hydrocarbon molecule is transformed into an isoelectronic molecule ion ($R_1R_2 \times NH_2^+$) in which a protonated nitrogen atom has replaced the ^{14}C. The fraction of disintegrations yielding $R_1R_2 \times NH$ after delivery of the proton is considered as retention. The retention turned out to be essentially the same for all compounds investigated. This result is in agreement with INDO calculations on the probability of electronic excitation as a consequence of the sudden increase in nuclear charge after β^- decay. Calculation of bond orders and charge distribution support evidence that only the direct environment of the transformed atom is affected. (GE)

18209 CHEMICAL CONSEQUENCES OF NUCLEAR TRANSFORMATIONS IN SOLIDS. Venkateswarlu, K. S.; Ramshesh, V. (Bhabha Atomic Research Centre, Bombay). Indian J. Chem. Educ. 3: No. 2, 2-6 (Nov 1972).

Studies on chemical radiation effects in solids as a result of irradiation with thermal neutrons are discussed and reviewed with special reference to cobalt complexes and work done at Bhabha. Complete chemical bond rupture is observed in gases and dilute solutions after irradiation, but in solids, the parent molecule retains much of the activity. This "retention" effect is known as Szilard–Chalmers effect. Retention is found to increase with annealing which can be thermal or radiation. After briefly describing postirradiation behavior of oxyanions, taking K_2CrO_4 as an example, work done on post-irradiation behavior of cobalt complexes is summarized with respect to various factors, namely, initial retention, thermal annealing, role of ambients, annealing kinetics, role of water of hydration, influence of radiation, and phenomenon of isotopic exchange. To explain behavior of cobalt complexes on irradiation, two models are proposed: i) the variable-depth electron trapping exchange model and ii) the exciton-induced exchange model. They are discussed and comparatively evaluated and it is concluded that the exciton-induced exchange model is more satisfactory. In the end, the physical methods based on i) semiconductivity, ii) thermoluminescence, and iii) Moessbauer spectra are briefly described. (INIS)

18210 RELATIVE EFFICIENCIES OF HYDROGEN ABSTRACTION BY RECOIL PHOSPHORUS ATOMS. Zeck, O. F.; Gennaro, G. P.; Tang, Y. N. (Texas Agricultural and Mechanical Univ., College Station). J. Chem. Soc., Chem. Commun.; No. 2, 52-53 (16 Jan 1974).

The relative efficiencies of hydrogen abstraction by recoil phosphorus atoms in the gas phase were found to cover a range of two orders of magnitude for five different molecules (CH_4, neo-C_5H_{12}, C_2H_6, SiH_4, PH_3) and correlated well with a possible bond-strength effect. (auth)

Properties of Radioactive Materials

Refer also to abstracts 18059, 18075, 18135, 18810, and 20522.

18211 (CEA-R-4477) CONTRIBUTION TO THE STUDY OF TETRAVALENT PLUTONIUM HYDROLYSIS AND COMPLEXING BY ACIDS OF BIOLOGICAL INTEREST. Metivier, H. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Nov 1973. 90p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis. Submitted to Paris Univ. (France).

In biological media having a pH around 7, the mononuclear hydrolysis of Pu^{4+} was investigated between H^+ = 1 M and pH = 7.5 by means of solvent extraction by compound formation with chelating agent and using the isotope of mass number 238, which allowed studies at low concentrations: 10^{-7}, 10^{-8} M. The distribution of plutonium was studied in the following systems: H^+, Li^+, ClO_4^-, μ = 1/benzene, HA = TTA (thenoyl-2-trifluoroacetone), DBM (dibenzoylmethane), IPT (isopropyltropolone), the oxidation state being maintained by addition of $K_2Cr_2O_7$ or $NaNO_2$ in order to avoid the reduction of tetravalent plutonium. The following values of hydrolysis constants K_n were obtained graphically then more accurately by computer: $\log K_1 = -0.45$, $\log K_2 = -0.75$, $\log K_3 = -3.3$, $\log K_4 = -6.3$. In the presence of citrate and isocitrate ions, in the ranges of pH and concentrations investigated, 10 citric and 6 isocitric complexes were demonstrated, three of them being largely predominant in each case. At pH > 5 and 10^{-5} M < C_{HpL} < 10^{-1} M, C_2^{4-} complexes were predominant; the formation constants of both species were $\log \beta = 34$ (Cit), $\log \beta = 33$ (Isocit). Beyond $H^+ = 0.1$ M the cisaconitic and α-cetoglutaric acids led to insoluble compounds. (auth)

18212 (CNEA-357) PREPARATION OF TOLUIDINE-^{131}I BLUE (3-AMINO-7-DIMETHYLAMINE-2-METHYLPHENAZOTHIONE-^{131}I. de Salas, G. N. B.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 8p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

The method proposed for the preparation of toluidine ^{131}I is the incorporation of radioiodine in the purified or unpurified dye using chloramine T as an oxidizing agent. A radiochemical yield of 98% was achieved. The labelled product was used for measurements in human beings with the Anger camera. (auth)

18213 (INP-839) RADIOTRACER STUDIES ON THE EXTRACTION OF METAL IONS. Part XV. Determination of Distribution and Stability Constants of Americium and Curium Chelates with Quadridentate Aromatic Schiff Bases. Stronski, I.; Rekas, M. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The distribution ratio D of tervalent americium and curium salts between 0.1 M bis-salicylidenoaldehyde-de-ethylenediminine (BSEDI) or 0.1 M bis-3-methoxysalicylidenealdehyde-ethylenediimine (B-3-MoxSEDI) in chloroform and aqueous phase was investigated in relation to pH in order to determine the distribution and stability constants of chelate formed. (auth)

18214 REDUCTION OF URANIUM HEXAFLUORIDE BY HYDROGEN AT ROOM TEMPERATURE. Levy, J. H.; Wilson, P. W. (Australian Atomic Energy Commission, Lucas Heights). Aust. J. Chem.; 26: No. 12, 2711-2714 (Dec 1973).

The reaction between uranium hexafluoride and hydrogen is catalyzed by hydrogen fluoride, especially in the presence of platinum metal. The catalyzed reaction has an observable rate at room temperature. The reaction provides the basis for the preparation of β-uranium pentafluoride on a laboratory scale. (auth)

18215 ABSORPTION OF URANYL IONS WITH ELECTRON-EXCITED LEVELS. Sergeeva, G. I.; Chibisov, A. K.; Karyakin, A. V.; Levshin, L. V.; Nemodruk, A. A.; Myasoedov, B. F. Zh. Prikl. Spektrosk.; 19: No. 3, 419-422 (Sep 1973). (In Russian).

Studies were made of the absorption of excited uranyl ions and processes of their prolonged persistence in aqueous solutions (neutral and acid) in the presence and absence of air and different quenching agents (ethanol, hydroquinone, tetravalent uranium, and potassium iodide). Measurements were made on the triplet–triplet energy transfer with excited uranyl donor on different acceptors. The studies were made at room temperature using the pulsed photolysis method. As a result of the study the singlet nature of the lower excited states of the uranyl ion was

established. The value of the extinction coefficient of the excited uranyl ion was determined and new absorption bands, characterizing the transfer with the lower excited levels of the uranyl ion to subsequent excited levels, were obtained. (tr-auth)

18216 STUDIES ON DIFFUSION AND MOBILITY OF TRITIUM IONS IN ZIRCON. Rozenfeld, B.; Pietrzak, R.; Paszkiewicz, B.; Sawicka, S. (Univ., Wroclaw). Nukleonika; 18: No. 10, 439-446 (1973). (In Polish).

Dependence of coefficient of diffusion of tritium in zircon on temperature was studied. The velocity of migration of tritium in zircon in externally adjacent electric field depending on the intensity of field was also studied. Investigations were carried on in a temperature range of 303 to 473°K, and in electric fields of intensity from 0 to 0.05 $V \cdot cm^{-1}$. For measuring the changes of tritium concentration in the area of the examined samples, natural beta radiation of tritium was exploited. The averaged results for large series of measurements lead to the following dependence of diffusion coefficient on the temperature T(°K) for the examined temperature range: $D = 1.73\ 10^{-4} e^{-(4940/RT)}\ cm^2\ s^{-1}$. The velocity of migration u in the compartment of applied electric fields grows linearly with the field intensity E/V cm^{-1} in accordance with the equation: $u = 3.36\ 10^{-6}\ E + 2.2\ 10^{-3}\ cm\ s^{-1}$. The effective charge of ions of tritium Z, because of their migration in static electric field, reaches the value: Z = 2.05 of elementary charge. (auth)

18217 STUDY OF CARBON-11 RECOIL LABELLING OF AMINO ACIDS BY THE (γ,n)-REACTION. Trampisch, W.; Sattler, E. L. (Univ., Giessen, Ger.). (1973). vp.

From seventh international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

The possibility of using the (γ,n) reaction on ^{12}C for recoil labelling of organic molecules was tested. As we looked for the ^{11}C radioactivity in the original molecules, fast separation techniques had to be used to separate the nuclear and radiation chemical radiolysis products from the intact substance. Activated amino acids were separated by high voltage electrophoresis and the paper strip scanned for radioactivity. The distribution of the radioactivity at the ninhydrin positive spot was a measure of the labelling yield. From the results so far obtained, it was concluded that the yield depends not only on the chemical structure but also on the molecular environment. To support these results, amino acids were separated by ion exchange. In the case of methionine, preliminary results are also available on the metabolic behavior in rats. (GE)

18218 STABILITY CONSTANTS OF THE CHELATES OF o-BENZARSENIOUS OXIDE WITH Cu(II), Co(II), Ni(II), Zn(II), UO_2(II), AND La(III). Sekhon, B. S.; Parmar, S. S.; Pushkarna, S. K.; Chopra, S. L. (Punjab Agricultural Univ., India). Indian J. Chem.; 11: No. 8, 835-836(Aug 1973).

The proton–ligand stability constants of o-benzarsenious oxide and the stability constants of its complexes with Cu(II), Co(II), Ni(II), Zn(II), UO_2(II) and La(III) have been determined in 20% aq. ethanol using Bjerrum–Calvin pH titration technique. The log K_1^H value (μ = 0.1 *M*) is 5.85 at 35°C. The order of stability constants for 1:1 complexes is found to be La(III) > UO_2(II) > Cu(II) > Ni(II) > Zn(II) > Co(II). (auth)

18219 FIRST TERVALENT THORIUM IN AN AROMATIC COMPLEX: TRIS(CYCLOPENTADIENYL)THORIUM(III). Kanellakopulos, B.; Dornberger, E.; Baumgaertner, F. (Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett.; 10: No. 2, 155-160(Feb 1974). (In German).

An aromatic complex containing tervalent thorium (h^5-$C_5H_5)_3Th$ was prepared for the first time by sodium reduction of tris(cyclopentadienyl)thorium(IV) chloride in tetrahydrofuran in the presence of naphthalene. The compound has a violet color, is weakly paramagnetic, and is extremely sensitive to air and moisture. The results of infrared, magnetochemical, and x-ray studies on the compound are summarized. (auth)

18220 DECONTAMINATION. Philipp, H.; Wichmann, E. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 31p. (In several languages).

The bibliography with abstracts announces literature received at the library of the Nuclear Research Center, Karlsruhe, covering the period from October 1, 1971 to June 30, 1973. It is arranged by subject groups and includes author, report, and patent number indexes. (GE)

18221 METHOD FOR PREPARING IMMUNOLOGICALLY ACTIVE INSULIN LABELED WITH ^{131}I. Stelmasiak, T. (Inst. of Genetics and Animal Breeding, Jastrzebiec, Poland). Acta Physiol. Pol.; 23: 717-725(1972). (In Polish).

A method for preparing immunologically active insulin labelled with ^{131}I is presented. Twice-crystallized insulin with 25 U/mg biological activity was labelled with ^{131}I made by the Institute of Nuclear Research at Swierk near Warsaw. After purification, the labelled hormone had a specific activity of the order of 180 to 600 μCi/mg and a low degree of damage (0 to 3%). Paper chromatography was used for controlling the purity of the preparation obtained. (Nucl. Sci. Abstr. Pol.)

18222 TRIS-[BIS-TRIMETHYLSILYLAMIDO]-MONOCHLOROTHORIUM(IV): A 4-COORDINATED THORIUM COMPOUND. Bradley, D. C.; Ghotra, J. S.; Hart, F. A. (Queen Mary Coll., London). Inorg. Nucl. Chem. Lett.; 10: No. 3, 209-211(Mar 1974).

A report is presented on the reaction of anhydrous thorium tetrachloride with lithium bis-trimethylsilylamide in tetrahydrofuran solution at room temperature. After extraction, the new compound ThCl $[N(SiMe_3)_2]_3$ was identified. It was characterized by NMR and IR spectra, m.p., and other physical and chemical properties. It is found to be monomeric, implying a 4-coordination for the thorium atom. (UK)

Radioactive Waste Treatment

Refer also to abstracts 18136, 18139, and 20230.

18223 (BARC-688) TRANSFORMATION OF INDIAN BENTONITES TO SODALITES AND THEIR UTILISATION IN RADIOACTIVE WASTE TREATMENT. Brat, S.; Balu, K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

Three naturally occurring bentonites (viz. Bihar bentonite, Rajasthan bentonite, and Saurashtra bentonite) of Indian origin were transformed to "sodalites" by continuously boiling them at atmospheric pressure with 1M (NaOH + NaCl) solution, for a period of 72 hr. The transformed products were utilized for their mineralogical and sorptive studies. These transformed products were found to be quite favorable for the removal of Cs^+ and Sr^{2+} ions from the radioactive liquid wastes. (auth)

18224 (HW-65727) REMOVAL OF PLUTONIUM FROM 234-5 SUMP WASTES AND FROM RECUPLEX EXTRACTION WASTES. Bruns, L. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 22 Jun 1960. 5p. Dep. NTIS $3.00.

Declassified 29 Mar 1973.

Methods for removal of plutonium from sump wastes and from Recuplex extraction wastes are described. For the sump waste a cation exchange column using Dowex 50 resin is used. A static column packed with ½-in. raschig rings is used for the extraction wastes. (LK)

18225 (INIS-mf-766-11, pp 119-130) BASIC ASPECTS OF APPLICATION OF BIOSORBENTS PREPARED FROM MYCELIA OF PENICILLIUM CHRYSOGENUM. Stamberg, K. (Vyvojovy Zavod Uranoveho Prumyslu, Zbraslav nad Vltavov, Czech.); Jilek, R.; Prochazka, H.; Hulak, P.; Katzer, J. [nd]. (In Czech).

The over-all character of sorption processes taking place on biosorbents of the fungus mycelium type resembles sorption on chelate resins. The selectivity of biosorbents as a whole is determined mainly by components of the protein, hexosamine, and polysaccharide type. The results obtained so far indicate that, for example, the retention of heavy metals, alkali earth metals, and alkali metals is effected by ion exchange; chelate formation; sorption-precipitation; or by a combination of these mechanisms. The sorption-precipitation mechanism combines the advantages of sorption (capability of regeneration and simple technology) with those of precipitation or, possibly, coprecipitation (high decontamination efficiency). The method is well suited for the decontamination of radioactive waters, such as waste waters discharged during radioactive raw materials exploitation and processing, waters contaminated with the corrosion and fission products from nuclear power stations, etc. It is also estimated that the method can be applied in the treatment of water contaminated by inorganic components. (INIS)

18226 (INIS-mf-766-12, pp 131-142) BINDING OF URANIUM TO CELLULAR COMPONENTS OF PENICILLIUM CHRYSOGENUM. Jilek, R. (Vyzkumny Ustav Veterinarniho Lekarstvi, Brno-Medlanky, Czech.); Prochazka, H.; Stamberg, K.; Hulak, P. [nd]. (In Czech).

Mycelia of the Penicillium chrysogenum were fractionated and information was obtained on the binding capability of biopolymers of protein and hexosamine types with regard to uranium. The binding of uranium to the components of the fungus mycelium was investigated in connection with the study of cultivation of fungi in

uranium mines. The modelling of natural conditions showed that the uranium content in the medium decreased in the course of cultivation and that uranium could be detected in the mycelium and in the spores of the fungus. It was also ascertained that the fungi could bind a certain amount of uranium both in the native state and after thermal denaturation resulting in an irreversible change in the organism. Possibilities are indicated of the industrial application of the fungus in water decontamination. (INIS)

18227 (INIS-mf-766-13, pp 143-149) APPLICATION OF BIOSORBENTS PREPARED FROM MYCELIA OF PENICILLIUM CHRYSOGENUM IN DECONTAMINATING WASTE WATERS FROM CZECHOSLOVAK URANIUM MINES. Hulak, P. (Ceskoslovensky Uranovy Prumysl, Mydlovary); Stamberg, K.; Prochazka, H.; Stastny, K. [nd]. (In Czech).

Laboratory research into the application of mycelia of the strain Penicillium chrysogenum for the sorption of uranium from water showed that the fungus has fairly good sorption properties but rather bad mechanical properties. The mechanical properties were therefore improved by hardening while maintaining the sorption properties. Attention was focused on the following procedures: fixation of the biomass into a synthetic, organic macrostructure; fixation of the biomass into a natural or a modified natural macrostructure; hardening, e.g., by formaldehyde, epichlorohydrin, etc. The hardening components were selected according to the availability, the price, the nature of the macrostructure, and the requirement for a maximum simplicity of the hardening process. The optimum hardening method was selected out of 12 variants using cost benefit analysis. The experiments confirmed that biosorbents can be employed in decontaminating water with the initial uranium concentration ranging from approximately 1 to 10 mg/l to the resulting concentration of 0.05 mg/l. (INIS)

18228 (ORNL-TM-4454) LOW-LEVEL WASTE TREATMENT LABORATORY STUDIES: EVAPORATION OF SIMULATED ION-EXCHANGE ELUATES. Moore, J. G. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 15p. Dep. NTIS $3.00.

To aid in the final design of the proposed new ORNL Low-Level Waste Treatment Plant, evaporation studies were made with solutions simulating the eluates from the Scavenging–Precipitation Ion-Exchange or the Clarification-Ion-Exchange process, that is, 0.08 M $Ca(NO_3)_2$–0.34 M HNO_3 and 0.20 M $Ca(NO_3)_2$–3.78 M HNO_3, respectively. Data are presented showing the variation of the nitric acid concentration in the residues and distillates as a function of the calcium concentration in the residues, the temperatures involved, and the percentage of acid removed from the residue as a function of the percentage of the initial solution volume that was evaporated. The resulting evaporator bottoms could be neutralized to a pH of 7 to 9 with 1 to 3 M NaOH without precipitate formation. (auth)

18229 (SZS-149, pp 29-41) CALCULATION OF ION EXCHANGE PROCESSES IN TREATING RADIOACTIVE WATERS. Bosholm, J. Mar 1973. (In German).

According to existing methods calculation of the separation of trace components from carrier-free or salt-containing waters by means of ion-exchange columns is possible only to a limited extent. Starting from the mechanism of the column process it is shown that the migration of the exchanging front is influenced by the distribution ratio as well as the limited resin capacity. Taking into consideration this fact a completion of the formulas of Glueckauf is proposed, and various methods of its numerical solution are explained. The factors to be used in the formulas are discussed and examples of their application are presented. The method is especially essential for the calculation of the treatment of radioactive waters with ion exchange resins. (auth)

18230 PROCESSING AND DEPOSITION OF RADIOACTIVE WASTES. Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie, Vienna). pp 1-4 of Umweltschutz: Staedtereinigung. Vienna; Oesterreichische Studiengesellschaft fuer Atomenergie GmbH (1972). (In German).

The different procedures used in the processing of solid, liquid, and gaseous radioactive wastes are summarized. (JSR)

18231 EVALUATION OF THE USEFULNESS OF A WATER DEACTIVATION FILTER. Grossman, A. (Politechnicka Slaska, Gliwice, Poland); Kwapulinski, J. Gaz, Woda Tech. Sanit.; 46: 412-414(1972). (In Polish).

Analysis of the slow filter performance proved that it does not guarantee safety in case of nuclear danger by providing the required capacity to remove from water radioactive substances amounting to 97%. (auth)

Radioisotope Production

18232 (MNC-4028-12, pp 85-86) PRODUCTION OF 22-HR ^{42}K. Walters, W. B. 1 Nov 1973.

In research in nuclear chemistry.

18233 FAST AQUEOUS CHEMISTRY ON-LINE WITH CYCLOTRON-PRODUCED ACTIVITIES USING A HELIUM-JET RECOIL-TRANSPORT SYSTEM. Kosanke, K. L.; McHarris, W. C.; Warner, R. A.; Kelly, W. H. (Michigan State Univ., East Lansing). Nucl. Instrum. Methods; 115: No. 1, 151-155(1974).

A relatively simple system is described that can be used to perform fast on-line chemical separations (≤1 s) on activities transported to low background areas in the relatively short times provided by a helium-jet recoil-transport system. The helium-jet recoil-transport system is run with its low-pressure end at atmospheric pressure, thereby eliminating the need for vacuum pumps and their associated apparatus. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 18057, 18090, 18261, 18262, 18319, 18322, 18346, 20031, 20032, 20091, and 20341.

18234 (K-L-6325) SOLVENT PURIFICATION SYSTEM FOR THE FLUOROCARBON ABSORPTION SYSTEM. Dunthorn, D. I.; Stephenson, M. J. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 16 Jul 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

A solvent purification system consisting of a distillation column with reboiler and condenser auxiliaries is described. The solvent purification system involves the application of the selective absorption process used for krypton–xenon removal to off-gas decontamination in a liquid metal fast breeder reactor fuels reprocessing system. By adding a solvent purification step to the fluorocarbon absorption system, the process can become a recovery step for impurities such as iodine and nitrogen dioxide that collect in the recirculating system. (LK)

18235 (ORNL-3763) BURN-LEACH PROCESS FOR RECOVERY OF URANIUM FROM ROVER FUEL: TERMINAL REPORT OF LABORATORY DEVELOPMENT. Ferris, L. M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1965. Contract W-7405-eng-26. 34p. Dep. NTIS $3.75.

Declassified 30 Aug 1973.

Several aqueous methods for recovery of uranium from irradiated NbC-lined graphite-base Rover (nuclear rocket) fuels were evaluated on a laboratory scale. The burn-leach process, which is described in this report, is considered to be the simplest and best of the aqueous methods. In the first step of this process, the fuel is burned at 700 to 750°C, preferably in a fluidized-bed of inert alumina. Volatilization of all fission products except ruthenium is expected to be low during combustion. The fluidized-bed product is transferred to a leacher and is leached first with hot 6 to 10 M HNO_3 to recover 95 to 99% of the uranium; then, the residue is leached at 115°C with 10 M HNO_3–5 M HF (F/Nb mole ratio of about 10) to recover the remaining 1 to 5% of the uranium and practically all of the niobium. After leaching, the system is washed with water and all solutions are combined, along with the appropriate amount of aluminum nitrate solution, to produce a final solution having the composition 3 M HNO_3–1 M total F–0.06 M $UO_2(NO_3)_2$–0.1 M H_2NbOF_5–0.2 M $Al(NO_3)_3$. The uranium can be recovered from this solution and decontaminated by conventional tributyl phosphate solvent extraction procedures. Because the burnups of the Rover fuels are quite low (<0.04 at.%), plastic or plastic-lined vessels can be used for containing the highly corrosive HF–HNO_3 solutions in the leaching and feed adjustment steps. With aluminum nitrate present in the feed solution, rates of corrosion of types 309SCb and 347 stainless steels were <0.4 mil/month at room temperature, indicating that these alloys could be used as materials of construction for the solvent extraction system. Combustion of Rover fuel in a fixed-bed burner at 700 to 800°C has also been studied. The U_3O_8–Nb_2O_5 combustion ash (even that produced at 1200 to 1300°C) can be dissolved in HF–HNO_3 (F/Nb mole ratio of about 10), using the two-stage leaching process. However, fixed-bed burning may not be as satisfactory as fluidized-bed burning because of engineering problems. Direct leaching of the ash (from either a fluidized-bed or fixed-bed burner) with 10 M HNO_3–5 M HF is an alternative to the two-stage leaching procedure but is not as practicable. Uranium and niobium recoveries are slightly lower in the direct leaching method; furthermore, uranyl fluoride will precipitate from the leach solution unless it is diluted with water while still hot. (auth)

18236 (RT/ING-(73)8) SAFETY REPORT OF THE ITREC PLANT. Stampone, E. (Comitato Nazionale per l'Energia Nu-

cleare, Rome (Italy)). 24 Jan 1973. 202p. (In Italian). Dep. NTIS (U. S. Sales Only) $12.25.

A safety study is made of the ITREC plant, an installation for the reprocessing of irradiated uranium–thorium fuel elements. The site and the plant itself are described in detail. The auxiliary services are discussed. The flowsheet of the installation is described. The chemical and ceramic processes that occur in the reprocessing of the irradiated fuel and fabrication of new fuel elements are reported. The criticality problems in this plant and the precautions taken to prevent criticality are discussed. The means taken to control radiations and to prevent personnel exposure are described. The processing of the liquid, gaseous, and solid wastes resulting from the reprocessing and fabrication processes is outlined. Possible malfunctions and operating errors and the preventive precautions are discussed. The maximum possible incident is examined. (JSR)

18237 SOLVENT EXTRACTION IN THE ATOMIC ENERGY INDUSTRY. Jenkins, I. L.; Wain, A. G. (Atomic Energy Research Establishment, Harwell, Eng.). Rep. Progr. Appl. Chem.; 57: 301-307(1972).

Reference is made to some of the papers presented at recent international conferences on the processing of nuclear fuels. Succeeding sections review briefly processes and plant under the following headings: uranium extraction; processing irradiated fuels; uranium–thorium fuels; plutonium recovery and purification; neptunium recovery; the rarer actinides; general considerations (e.g., of solvent performance; extraction conditions). (UK)

18238 REDUCTIVE ELECTROLYTIC PLUTONIUM–URANIUM SEPARATION IN THE MIXER–SETTLER. Hausberger, H. Heidelberg; Heidelberg Univ. (1972). 88p. (In German).

The electrolytic method of reducing Pu(IV) to Pu(III) has been elaborated and optimized with the goal of performing the plutonium–uranium separation process in the mixer–settler itself. Minimum variations of conventional mixer–settlers have brought about an electrolytic reduction directly at the site of extractive separation. The mixer–settler itself made from compact titanium serves as the working cathode. The anode chamber is designed so as to avoid all difficulties normally accompanying the electrolytic reduction in moving systems of two phases, and the hydrodynamics of the mixer–settler is not influenced by the structural components. Without any additions of non process-inherent substances and without isotope dilution, the reduction-separation step can be performed with the aid of direct electrolytic reduction within the mixer–settler. The final separation factor is at least as high as that achieved with the addition of reducing agents. However, the waste volume is smaller and the fuel solutions need not to be changed. (GE)

18239 HIGH-PRESSURE ION EXCHANGE AND ITS APPLICATION IN THE REPROCESSING OF HIGHLY RADIOACTIVE MATERIALS. Goldacker, H.; Weinlaender, W.; Roeder, L. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From 24th UPAC congress; Hamburg, Germany (2 Sep 1973).

Rapid chromatographic separation processes proved to be particularly suitable for the separation of highly radioactive substances, as e.g. for the separation of Am, Cm isotopes or the separation of ^{252}Cf. The processes involved in the use of high-pressure columns, such as the effect of pressure on the packing mode and the separation process itself are examined in detail, with the tests being restricted for the time being to idealized separation processes (i.e., to those using trace amounts). (GE)

18240 MATERIAL BALANCING AT THE JUELICH REPROCESSING PILOT PLANT JUPITER. Brodda, B. G.; Filss, P.; Litzow, W.; Merz, E.; Wenzel, U. (Kernforschungsanlage, Juelich, Ger.). Z. Anal. Chem.; 267: No. 4, 281-286(Dec 1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Germany (2 Apr 1973).

Reprocessing of spherical THTR fuel elements shall be tested in the Juelich pilot plant JUPITER. This fuel type differs significantly from other fuel elements with respect to shape, composition, and fissile material content. It requires special provisions for reprocessing and the necessary material balancing and safeguarding. Two material balance areas (MBA) are defined: head end and chemical extraction process. Within the first area uranium and thorium are balanced mainly by using a combination of digital counting of the fuel spheres, gamma spectrometric burnup determination of individual spheres and x-ray fluorescence determination of uranium and thorium in nitric acid solutions obtained by dissolution in Thorex reagent of the heavy metal oxides after burning of the graphite matrix. The second MBA begins with the solution for the chemical extraction process, collected in the so-called accountability tank. After extraction according to the Thorex flowsheet the process streams are monitored in line for process control, and off line material balancing and safeguarding. This is performed mainly by x-ray fluorescence analysis, potentiometric titrations, and alpha and mass spectrometry. (GE)

18241 USE OF SOLVENT EXTRACTION IN THE PROCESSING OF ELECTRONUCLEAR REACTOR FUELS. Miquel, P. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 184, 57-78(Sep 1973). (In French).

Solvent extraction in the nuclear industry is reviewed, and the Purex process (the process normally used to process irradiated fuels) is described. A description is given of the technology and the methods developed to adapt this process to the processing of power reactor fuels. (FR)

18242 IN-LINE ANALYTICAL METHODS FOR FUEL REPROCESSING STREAMS. Part I. Direct Colorimetry of Uranium and Free Acid. Bhargava, V. K.; Chardrasekharn, E. S.; Iyer, R. H.; Rao, V. K.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay). Indian J. Appl. Chem.; 35: No. 1, 47-54(1972).

As part of a program of development work on in-line monitoring systems for the continuous assay of U, Pu, fission products, and free acid in process streams, detailed investigation of a nondestructive, direct colorimetric method for uranium and free acid has been carried out. The method makes use of the yellow color of the uranyl ion. Determinations of uranium in aqueous and organic (TBP) phase were carried out in the range 2-30 g/l. The method could be easily extended to much higher concentrations by using differential colorimetry. Free acid could be determined in the range 0.5 to 4.5 M with an accuracy of ±0.1 M. Effect of interfering metallic corrosion and fission product ions is also discussed. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 19409, 19883, 20407, 20421, and 20443.

18243 (JAERI-M-5207) ANALYSIS OF THE RELAXATION PHENOMENA IN NONEQUILIBRIUM MHD GENERATOR BY FOUR-TERMINAL NETWORK THEORY. Shirakata, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1973. 40p. (In Japanese). NTIS (U.S. Sales Only).

By extending the method for two-dimensional analysis of the electrical characteristics of a nonequilibrium MHD generator using four-terminal network theory, the relaxation phenomena in a multi-electrode generator was studied. It is possible by this technique to examine the relaxation phenomena in the multi-electrode generator as a whole, which usually defies the conventional methods. Numerical calculations were made on the Faraday generator which has 32 electrode pairs and preionizers. The variations in electron density, electron temperature, and output current along the generator channel are evaluated, taking into consideration the effects of wall leakage current and electro-thermal instability. (auth)

18244 TERMOEMISSIONNYE PREOBRAZOVATELI I NIZKO-TEMPERATURNAYA PLAZMA. (Thermoemission Converters and Low-Temperature Plasma). Moizhesa, B. Ya.; Pikusa, G. E. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1973). 480p.

The book is devoted to a discussion of the physical processes connected with the thermoemission conversion of heat into electrical energy. Basic consideration is given to the operation of plasma conversion diodes. Conversion regimes and phenomena occurring on the electrode surface are examined. The elementary processes and the kinetic phenomena in the plasma volume are studied. The phenomena adjacent to the electrode and the approximate boundary conditions for the transport equation are examined. Experimental and theoretical investigations of the plasma of thermoemission converters are discussed. Questions on the practical use of thermoemission converters in self-contained systems are briefly discussed. (tr-auth)

18245 FIBER OPTICAL SOLAR COLLECTOR. Swet, C. J. (to Secretary of the Navy). US Patent 3,780,772. 25 Dec 1973. Filed date 26 Apr 1972. 6p.

An improved solar collector comprising a fiber optical solar receiver which passively concentrates incident solar energy for delivery as an intensified flux to an absorptive target is described. In one embodiment of the invention, the present solar collector comprises a boule of fibers shaped into an accurate collecting surface at one end, the fibers tapering to a flat output plane at the opposing end of the boule. Solar radiation entering the collector at the collecting surface is concentrated within the tapered portion of the boule and delivered as an intensified flux to an absorptive target disposed in operative relation to the output plane, the absorptive target being either a cookpot, a thermal storage mass, or the hot junction of a thermoelectric generator. (Official Gazette)

18246 NaK-NITROGEN LIQUID METAL MHD CONVERTER TESTS AT 30 kW. Cerini, D. J. (Jet Propulsion Lab., Pasadena, CA). AIAA (Amer. Inst. Aeronaut. Astronaut.).J.; 12: No. 1, 78-83(Jan 1974).

A NaK-nitrogen liquid metal MHD converter was operated over a range of nozzle inlet pressures of 100 to 165 N/cm^2, NaK flowrates of 46 to 72 kg/sec, and nitrogen flowrates of 2.4 to 3.8 kg/sec. The generator was operated as an eight-phase linear induction generator with two of the eight phases providing magnetic field compensation to minimize electrical end losses at the generator channel inlet and exit. Each of the eight phases was connected to a separately controlled capacitor bank for magnetization reactive power and a separately controlled load bank for dissipation of the output power. Generator operation was obtained with average winding currents and voltages up to 80 amp and 500 V, respectively, with estimated channel magnetic fields up to 0.4 T over the range of frequencies of 270 to 470 Hz. The output power of the converter was varied from −6 to 31 kW. At maximum output, the winding losses, fluid friction losses, and fluid ohmic losses were estimated to be 18, 21, and 49 kW, respectively, for a sum of 119 kW extracted from the fluid corresponding to net and gross efficiencies of 31/119 = 0.26 and (31 + 18)/119 = 0.41, respectively. (auth)

18247 USES OF NUCLEAR ENERGY IN SPACE FLIGHT. I. Hollax, E. (Astronautische Gesellschaft, Dresden). Kernenergie; 16: No. 10, 305-310(Oct 1973). (In German).

In space flight, nuclear energy has previously been used or proved for generation of electric, transport, and heat energy as well as for purposes of analysis and will gather strong momentum in the future. The uses so far realized for generating electric power and with the appropriate development for future undertakings are discussed. The coupling of thermoelectric, thermionic, magnetoplasmadynamic, and Brayton-type conversion with reactors of various types or with radionuclides is taken into consideration. (auth)

18248 DESIGNING MHD GENERATOR SYSTEMS FOR MINIMUM POWER PRODUCTION COSTS. Buende, R.; Raeder, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Energy Convers.; 13: No. 4, 143-148(Dec 1973).

The calculation of the thermodynamic and electrical data, on the one hand, and the power production costs, on the other, of a kerosene-oxygen fired supersonic MHD generator was taken as a starting point to study the influence of the design parameters on the power production costs. The results of this investigation allow optimum design of the MHD power plant as regards power production costs and operational safety. (auth)

Facilities and Equipment

Refer also to abstracts 18334, 18666, 18807, 19001, and 20574.

18249 (AAEC/E-281) REVIEW OF FLUORINE CELLS AND FLUORINE PRODUCTION FACILITIES. Ring, R. J.; Royston, D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1973. 148p. Dep. NTIS (U. S. Sales Only) $9.50.

The development of laboratory and industrial scale electrolytic cells used for the generation of fluorine is reviewed and the construction and operating characteristics of these cells are examined in detail. In addition, the associated facilities required for the supply and treatment of raw materials, treatment of product gases and disposal of waste materials are described. Safety practices adopted in the design and operation of equipment including personnel protection and first aid procedures are also outlined. (auth)

18250 (HEDL-TME-73-23) VIBRATORY MOTION OF THE HCM TEST STAND. Hill, R. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1973. Contract (AT(45-1)-2170. 110p. AT.

A primary function of the FFTF Hydraulic Core Mockup (HCM) is to verify the design of the reactor vessel components for the propensity to vibration. In order to examine the vibration properties of the reactor vessel components it is necessary to decouple and define the reactor vessel suspension frequencies. Hence, analyses have been performed to determine the natural frequencies of the HCM test stand and the coupling between the test stand and the vessel. The effect of the inlet-outlet piping on the vessel suspension frequencies is shown. These analyses show that the test stand vessel support system satisfies the design objectives. (auth)

18251 (HEDL-TME-73-82) PROTOTYPE APPLICATIONS LOOP (PAL) AND SODIUM CHARACTERIZATION SYSTEM (SCS) INVESTIGATIONS: VAPOR TRAP PERFORMANCE, COVER GAS ANALYSIS, AND INTERPRETATION OF ANALYSES. Barton, G. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 34p. Dep. NTIS $4.00.

The argon cover gas of the Prototype Applications Loop (PAL) was sampled and analyzed by a process (on-line) gas chromatograph after it had passed through a HEDL-designed vapor trap. Evaluation of vapor trap and chromatograph performance for the first year of operation was satisfactory. The vapor trap and aerosol filter prevented sodium transport into the gas circulation pump and chromatograph. The chromatograph measured the major gaseous impurities of hydrogen, nitrogen, and methane. Hydrogen concentration ranged from 0.5 to 380 ppm (vol) and nitrogen concentration from 5 to 2000 ppm. Concentration changes could be related to operations on the sodium system such as changing temperature, attaching samplers, etc., as well as cold trap operation. Methane was observed only a few times and these were after starting sodium flow through freshly attached sampling equipment. Unequivocal evidence of oxygen in the cover gas was observed only once in approximately a year of operation. (auth)

18252 (HSSTP-TR-28) ELASTIC-PLASTIC BEHAVIOR OF A LONGITUDINAL SEMI-ELLIPTIC CRACK IN A THICK PRES-

SURE VESSEL. Marcal, P. V.; Stuart, P. M.; Bettes, R. S. (Brown Univ., Providence, R. I. (USA). Div. of Engineering). Jun 1973. Subcontract 3153. 38p. Dep. NTIS $4.00.

For Oak Ridge National Lab., Tenn.

A review of previous work on finite element analysis of three-dimensional flawed structures is presented. New work on a special crack tip element is then reported. The crack tip element was formed from an eight node isoparametric element by coalescing pairs of nodes around the crack boundary. Meshes generated in this way gave good results for stress intensity factors even for coarse meshes. Results were obtained for a semi-elliptical crack in a tensile specimen and a thick-walled cylinder. An elastic-plastic analysis of the flawed thick-walled cylinder was performed. (auth)

18253 (REG/G-3.12(8-73)) GENERAL DESIGN GUIDE FOR VENTILATION SYSTEMS OF PLUTONIUM PROCESSING AND FUEL FABRICATION PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Aug 1973. 6p. DRS.

At plutonium processing and fuel fabrication plants, a principal risk to health and safety is the release and dispersal of radioactive materials. The prevention of such release and dispersal is an important function of the ventilation systems. This regulatory guide presents methods acceptable to the Regulatory staff for complying with requirements for the design of ventilation systems for plutonium processing and fuel fabrication plants. (TFD)

18254 (RFP-1965) DESIGN DATA FOR HOLLOW CATHODE GAS-FED ARCS. Williams, D. G. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 19 Dec 1973. Contract AT(29-1)-1106. 18p. Dep. NTIS $4.00.

Engineering information is provided to fabricate and operate equipment for generating hollow cathode arcs. Topics include equipment selection and design, operating procedures, and operating characteristics. Hollow-cathode operating characteristics for a wide range of cathode sizes, gas-flow rates, gas types, and cathode-anode spacings are covered. (auth)

18255 (RFP-2074) MATHEMATICAL CENTERING ON THE RIGID ARM SWEEP GAGE. Seaverson, L. A.; Roberts, O. K.; Burnham, M. W.; De Penning, D. L. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 18 Dec 1973. Contract AT(29-1)-1106. 9p. Dep. NTIS $4.00.

Mathematical Centering, a technique which corrects measurement errors due to part misalignment on the Rigid Arm Sweep Gage, has been in general use at Rocky Flats Plant since October 1972. History of the need and development is included. Described also is a theory to explain why some parts appear to be less accurately made when mathematical centering is used than when not used. Capabilities and operator options are discussed and a flow chart given of the basic logic which the computer control program applies. Derivations of formulas have been included in an appendix. (auth)

18256 (RFP-2134) EVALUATION OF THE CRYOFIT TUBE JOINING SYSTEM IN SELECTED PLUTONIUM CHEMICAL PROCESSING SOLUTIONS. Macki, J. M.; Terada, K.; Kochen, R. L. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 27 Dec 1973. Contract AT(29-1)-1106. 8p. Dep. NTIS $4.00.

The Ni-Ti alloy Cryofit joining system has been evaluated for corrosion resistance to selected solutions encountered in the chemical processing of plutonium. Results indicated the Cryofit system has useful resistance to $Al(NO_3)_3$, $H_2C_2O_4$, KOH, and very dilute H_2SO_4. The Cryofit system is not suitable for HNO_3 service or for NH_4SCN service when used with 304 stainless steel. The Cryofit tube fitting system provides a means of connecting tubes and pipes without flanges, welds, or elevated temperatures. Permanent connections are made by removing a Cryofit coupling from liquid nitrogen and inserting the tubes to be joined into the ends of the coupling. As the coupling warms from liquid nitrogen to room temperature, it shrinks onto the tubing with tremendous force generated by internal stresses. (auth)

18257 (RT/ING-(73)13) OUT OF PILE FACILITY FOR HEAT TRANSFER TESTS OF NUCLEAR PLANT COMPONENTS PROTOTYPES. Campolunghi, F.; Cumo, M.; Palmieri, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 Aug 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

A 1- to 4-MW heat transfer loop for engineering tests in nuclear plant components is described in some detail, both for what pertains to the kind of tests which can be afforded and the constitutive features of the loop itself. Experimental research is mainly addressed to once-through steam generators and fuel element prototypes. The availability of full scale tests, close to actual situations, is underlined. (auth)

18258 (TID-26515) REPORT OF CURRENT STANDARDS FOR CONDENSERS AND CONDENSING SYSTEM PUMPS FOR AIR-COOLED STEAM POWER PLANTS. (Beck (R. W.) and Associates, Denver, Colo. (USA)). Dec 1973. Contract AT(04-3)-848. 72p. GPO $1.05.

Results of an investigation performed to review the current standards for condensing equipment and pumps which may apply to the condensing systems of large, air-cooled, steam power plants, are reported. (TFD)

18259 (WCAP-8224) COMBINED ANALYTICAL-EXPERIMENTAL FRACTURE STUDY OF THE TWO LEADING THEORIES OF ELASTIC-PLASTIC FRACTURE (J-INTEGRAL AND EQUIVALENT ENERGY). Riccardella, P. C.; Swedlow, J. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Oct 1973. Subcontract 3196. 50p. (HSSTP-TR-33). Dep. NTIS $4.50.

For Oak Ridge National Lab., TN.

The ability of a pressure vessel steel to resist fracture constitutes an important factor in ensuring nuclear reactor safety. Fracture mechanics is considered as providing the best general approach to understanding the brittle fracture phenomenon in reactor vessel steels. A comprehensive program to apply the technology of both linear elastic and elastic-plastic fracture mechanics to all foreseeable brittle and ductile failure aspects of heavy-walled nuclear pressure vessels is being developed. One important aspect of this program is the extension of linear elastic fracture mechanics concepts to the realm of elastic-plastic fracture mechanics technology. The application of the two leading theories of elastic-plastic fracture (J-Integral and Equivalent Energy) to a relatively simple test specimen geometry, using a two-dimensional, finite element computer program which is general enough to be applied later to more complex reactor vessel problems is reported. (TFD)

18260 METHODS AND APPARATUS FOR DISTINGUISHING BETWEEN BODIES ACCORDING TO THEIR TRANSLUCENCY. Reid, C. D.; Ritchie, I. D. (to United Kingdom Atomic Energy Authority). US Patent 3,786,266. 15 Jan 1974. Priority date 19 May 1969, United Kingdom of Great Britain and Northern Ireland. 12p.

Relatively opaque and relatively translucent bodies are distinguished from one another by illuminating a limited area of the surface of each body and determining the amount of light emitted from the surface of the body outside the limited area, the amount of such emitted light increasing with increasing translucency of the body. A coaxial light-transmitting and light-receiving arrangement is preferred, using a common lens, and using adjacent fibre-optic transmitting and receiving surfaces. The invention has one application in distinguishing between ore fragments which comprise a translucent matrix (e.g., quartz or quartzite) and greater or lesser amounts respectively of an opaque mineral (e.g., uraninite) non-uniformly dispersed therein, and can be applied to physically separate the fragments according to their mineral content. (Official Gazette)

18261 AUTOMATIC CALCULATION METHODS IN THE STUDY AND DEVELOPMENT OF LIQUID-LIQUID EXTRACTION PROCESSES. Rouyer, H. (CEN, Fontenay-aux-Roses, France); Demarthe, J. M. Bull. Inform. Sci. Tech. (Paris); No. 184, 49-56 (Sep 1973). (In French).

The various methods used in liquid-liquid extraction calculations are reviewed (developments from the MacCabe and Thiele method up to other methods which can be used in conjunction with computers). It is shown that computers can be used, in complex cases, to avoid tedious laboratory experiments, mathematical models being developed for the thermodynamic equilibria. The extraction of uranium is presented as an example. In addition computers allow studies to be effected on the optimization of the processes. Electronic computers and, in particular, hybrid computers can also play an important part in extrapolation and control studies. Simulation studies enabling the transient behavior of mixer-settlers to be studied are presented. Mathematical models for representing extraction columns are also given. (FR)

18262 SGN-ROBATEL EXTRACTORS WITH SEPARATED STAGES. Tarnero, M. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 184, 35-42 (Sep 1973). (In French).

The SGN-Robatel centrifugal extractor is described. The results obtained by the CEA for small extractors and industrial extractors are presented. The results concern the extraction of uranium using tributyl phosphate, the U-Pu partition, the decontamination factors, and the extraction of thorium nitrate by trilaurylamine. (FR)

18263 ELEMENTS FOR THE DESIGN AND OPERATIONAL DEVELOPMENT OF PULSED COLUMNS. Rouyer, H. (CEN, Fontenay-aux-Roses, France); Lebouhellec, J.; Henry, E. Bull. Inform. Sci. Tech. (Paris); No. 184, 29-34(Sep 1973). (In French).

Pulsed columns and their operation are described. The parameters involved in determining the capacity and efficiency of the columns are reviewed, i.e., parameters associated with the column (geometrical variables and operational variables); and parameters associated with the column (geometrical variables and operational variables). The extrapolation problem is mentioned. It is proposed that a mathematical model, which takes axial mixing into account, be used to treat the problem. Experimental results are given for measuring the axial mixing as a function of operational variables as well as results concerning the efficiency of a 300 mm diameter column. It is shown that the regulation and control of this apparatus is straightforward when the operational conditions are sufficiently remote from flooding. (FR)

18264 LIQUID–LIQUID EXTRACTION PROCESSES ON THE INDUSTRIAL SCALE. Michel, P. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 184, 19-27(Sep 1973). (In French).

Solvent extraction is a separation and purification operation being developed on the industrial scale. Many different types of apparatus were studied. They can be classed in two categories: extractors with separated stages, and continuous contact extractors. The choice of extractor for a particular purpose is governed by economical, technical, and reliability considerations. Several types of extractor are recommended. (FR)

18265 AEROSOL TECHNOLOGY IN HAZARD EVALUATION. Mercer, T. T. Monograph Series on Industrial Hygiene. New York; Academic Press, Inc. (1973). 402p. (TID-26522).

Following an introduction on the nature of inhalation hazards, the properties of aerosols, and the size and size distribution of aerosol particles, techniques for producing monodisperse and polydisperse aerosols for instrument calibration and inhalation experiments and techniques for measuring the concentration, size distribution, and respirable fractions of aerosols are discussed. These techniques include filtration; electrostatic precipitation; light-scattering measurements; horizontal and centrifugal elutriation and spectrometry; particle size distributions; definition and measurement of respirable activity; and measurement of diffusivity, surface area, and particulate volume. This work is of particular value to industrial hygienists and physicians, health physicists, inhalation toxicologists, and others involved in evaluating the hazards of inhaling toxic particles. (LCL)

18266 CONTINUOUS SEQUENTIAL AIR SAMPLER FOR ENVIRONMENTAL STUDIES. Zutshi, P. K.; Mahadevan, T. N. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Technol.; 11: No. 5, 230-232(May 1973).

A sequential sampler designed and fabricated from indigenous materials for continuous and simultaneous monitoring of different air pollutants is described. The sampler is simple in design and enables the collection of air samples automatically on four hourly basis. Some results obtained with the help of the sampler are presented. (auth)

18267 RING SLIT CENTRIFUGE (ENGINEERING MATERIALS). (Rochester Univ., N.Y. (USA)). (CAPE-2385).

10 drawings.

The design and the performance of a modified centrifuge which has an aerosol inlet in the form of a ring slit is described. The modification was conceived to facilitate high aerosol sampling rates at reasonable size resolutions in terms of aerodynamic diameters. In the size range between 4×10^{-4} and 1.3×10^{-5} cm., the instrument permits sampling rates of 1 liter per minute or more at a size resolution of better than 7%. In any single test run, a size range of about one order of magnitude can be resolved. These results seem to be close to the optimum performance data expected from theoretical considerations. For the size range between 1.3×10^{-5} and 6×10^{-6} cm., the sampling rate fell short of theoretical expectations and had to be reduced to about 0.1 liter per minute in order to give acceptable results. This rate is comparable with maximum sampling rates of other conifuge designs. It seems to be an upper limit at high rotor speeds and low linear flow velocities for conifuge versions with aerosol entrainment under tangential accelerating forces. (auth)

18268 FOURTH INTERNATIONAL CONGRESS OF CHEMICAL ENGINEERING, CHEMICAL EQUIPMENT DESIGN AND AUTOMATION, PRAGUE, CZECHOSLOVAKIA, SEPTEMBER 1972. A, B, C, D, E, F, G, H, I, J, K, L, M, and Program. Prague; CHISA Congresses (1972). vp. (CONF-720940–(abstr.)).

Abstracts of papers presented at the conference are given. The fields of interest included: laminar flow and non-Newtonian engineering mixing, fluid-solid separation, fluidization, fundamentals of heat and mass transfer, vapor liquid equilibria, rectification and absorption, adsorption and liquid extraction, industrial crystallization, reaction engineering, design and construction of chemical equipment and process engineering, and control of chemical processes and special measuring methods. (TFD)

18269 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Hayden, O.; Taylor, D. (to United Kingdom Atomic Energy Authority). British Patent 1,339,136. 28 Nov 1973. Filed Date 18 Sep 1970. 12p.

Reference is made to heat exchangers comprising tubes and tube plates. Problems can arise in the use of such a heat exchanger, particularly as a steam generator or superheater with a liquid metal heat transfer medium, such as Na, since any contact between water or steam and the liquid metal will cause a violent reaction. Welds must be of high integrity, and provision must be made to accommodate any distortion of the tubes due to thermal expansion. The heat exchanger described comprises an elongated shell with a removable closure head, and a bundle of U-shaped tubes with their inlets and outlets terminating, respectively, at an inlet and outlet header of standpipe form in the closure head, each header having a tube plate to which the tube ends are connected. A U-shaped shrouding is provided for the tube bundle so as to cause heat transfer fluid to flow in a U-shaped path along the outside of the tubes, while confined by the shrouding. A further tube plate may be provided, spaced from the tube plate in each header, with the space between the tube plates enclosed and means provided for testing the contents of the space for leakage between tubes and tube plates; this space may be Ar filled. The spaces in each header are accessible through a removable inspection cover, and a pressure relief device may be provided in the shrouding, venting to outside the heat exchanger shell. The tubes are spaced and located at intervals along their length by transverse grids, supported in an articulated manner, in order to accommodate any distortion due to thermal expansion. Construction details are given in full. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 18257, 18258, 18269, 20003, 20066, 20079, 20081, 20413, 20471, and 20554.

18270 (KFK-1854) PROCEDURE FOR THE DIRECT NUMERICAL SIMULATION OF TURBULENT FLOWS IN PLANE CHANNELS AND ANNULI AND ITS APPLICATION IN THE DEVELOPMENT OF TURBULENCE MODELS. Schumann, U. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Oct 1973. 257p. (In German). Dep. NTIS (U.S. Sales Only) $15.00.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

A numerical difference scheme is described to simulate three-dimensional, time-dependent, turbulent flows of incompressible fluids at high Reynolds numbers in a plane channel and in concentric annuli. Starting from the results of Deardorff, the Navier-Stokes equations, averaged over grid volumes, are integrated. For description of the subgrid scale motion a novel model has been developed which takes into account strongly inhomogeneous turbulence and grid volumes of unequal side lengths. The premises used in the model are described and discussed. Stability criteria are established for this method and for similar difference schemes. For computation of the pressure field the appropriate Poisson's equation is solved accurately, except for rounding errors, by Fast Fourier Transform. The procedure implemented in the TURBIT-1 program is used to simulate turbulent flows in a plane channel and an annulus of 5:1 ratio of radii. For both types of flow, different cases are realized with a maximum number of grid volumes of 65536. For rather small grid volume numbers the numerical results are in good agreement with experimental values. Especially the velocity profile and the mean velocity fluctuations are computed with significantly better accuracy than in earlier, direct simulations. The energy–length-scale model and the pressure-strain correlation are used as examples to show that the method may be used successfully to evaluate the parameters of turbulence models. Earlier results are reviewed and proposals for future research are made. (auth)

18271 (PEM-15) NUCLEAR EMP: MEASURING CONNECTOR SHIELDING EFFECTIVENESS DURING VIBRATION. Knowles, E. D.; Brossier, J. C. (Boeing Co., Seattle, Wash. (USA)). 1970. 13p. Dep. NTIS $3.00.

The equipment and techniques used to measure shielding effec-

tiveness of threaded electrical connectors during vibration are described. The vibration fixture is a modified coaxial trough of which the connector is a part. The connector is mechanically loaded with a short section of cable. A known current is applied on the shield of this short cable section and across the receptacle/plug interfaces. R-f leakage into the interior of the cable is determined by forming the interior wiring of the cable into a closed loop and measuring the current in this loop. The logarithmic ratio of the current in the shield to the current in the interior loop is the shielding effectiveness of the cable-connector combination. The cable shield is composed of brass convolute with a braid covering and provides, by itself, 100 dB isolation. This isolation was demonstrated by testing the shielding effectiveness (S. E.) of a baseline specimen which substituted a brass fitting for the connector. It is demonstrated that this method of testing connectors can be used to determine S. E. under vibration. The method is proposed as a standard method of qualification testing of connectors. (auth)

18272 ANNUAL REVIEW OF FLUID MECHANICS. Volume 6. Van Dyke, M.; Vincenti, W. G.; Wehausen, J. V. (eds.). Palo Alto, CA; Annual Reviews, Inc. (1974). 378p. $12.00.

The following topics on fluid mechanics are discussed: interaction between experiment and theory in fluid mechanics; harbor seiching; double-diffusive phenomena; waterhammer and surge control; sampling techniques in turbulence measurements; nonlinear dispersive waves; meaning of viscometry in fluid dynamics; atmospheric boundary layer below 150 m; superfluid mechanics; transport properties of two-phase materials in random structure; spin-up; numerical simulation of viscous incompressible flows; and aerodynamics of powered high-lift systems. An author index is included. (LCL)

18273 GENERALIZATION OF EXPERIMENTAL DATA ON HEAT TRANSFER BY NUCLEATE BOILING OF DISSOCIATING N_2O_4. Borishanskii, V. M.; Kolykhan, L. I.; Solov'ev, V. N. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Nauk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 38-42(1972). (In Russian).

A generalization of the test data on heat transfer during nucleate boiling of the chemically reactive system $N_2O_4 \rightleftharpoons 2NO_2$ is proposed. The equation differs from the usual equation for inert simple material with complex Gibbs number (Gi) which takes into account the behavior of the equilibrium thermodynamic properties of the phase near the saturation line during change of the regime parameters and affects the stability of the superheated liquid phase. (tr-auth)

18274 LOCAL BOILING HEAT TRANSFER ON NONISOTHERMAL SURFACES. Petukhov, B. S.; Kovalev, S. A.; Zhukov, V. M.; Kazakhov, G. M.; Geshele, V. D.; Shil'dkret, V. M. (Inst. of High Temperatures, Moscow). Heat Transfer-Sov. Res.; 5: No. 6, 154-159(1973).

An experimental study is described of local heat transfer with water and F-113 boiling on nonisothermal surfaces. For comparison results for isothermal surfaces are also presented. It is found that the maxima of heat fluxes are lower by several tens of percents as compared with isothermal conditions. Under transient conditions the heat flux density is, as a rule, higher by from 35 to 40%. It was found that results with acceptable accuracy can be obtained only at high heat fluxes and high wall-fluid temperature differences. The suggestion is made that the coexistence, under nonisothermal conditions, of several boiling modes results in mutual interference between them and in "smoothing" of the boiling curve. (auth)

18275 SINGLE PHASE TURBULENT MIXING IN SIMULATED ROD BUNDLE GEOMETRIES. Singh, K.; St. Pierre, C. C. (Univ. of Windsor, Ont.). Trans. Can. Soc. Mech. Eng.; 1: No. 2, 73-80 (Jun 1972).

Single-phase air and water turbulent mixing rates, between two square array subchannels simulating parallel flow areas in a reactor rod bundle array, were measured employing tracer techniques. Mixing rates increased with Reynolds number over the range 1,300 to 38,000. Variation of the interconnection gap spacing from 0.015 to 0.080 in. indicated that the mixing mechanism was both gap spacing and Reynolds number dependent. At low Reynolds number and low gap spacings, molecular diffusion plays an important role in the mixing mechanism. However, generation and penetration of secondary flows are believed to be an important mode of mixing in the intermediate Reynolds number range—the largest secondary flows and minimum penetration being encountered for the lowest pitch to rod diameter ratios. (auth)

18276 TWO-PHASE SYSTEMS. Proceedings of the International Symposium Held at Haifa, Israel, August 29-September 2, 2971. Hetsroni, G.; Sideman, S.; Hartnett, J. P. (eds.). Progress in Heat and Mass Transfer. Volume 6. Elmsford, NY; Pergamon Press, Inc. (1972). 675p. (CONF-710836-). $60.00.

Thirty-nine papers were presented. A separate abstract was prepared for each of 17. The remaining 22 papers on two-phase systems were not in scope for NSA. (LCL)

For abstracts of individual papers see: 18277-18293.

18277 STATUS OF AND PROBLEMS IN BOILING AND CONDENSATION HEAT TRANSFER. Rohsenow, W. M. (Massachusetts Inst. of Tech., Cambridge). Progr. Heat Mass Transfer; 6: 1-44(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Our knowledge of heat transfer associated with boiling and condensation has been advanced considerably in the last two decades from the mysterious experimental data for overall coefficients for special geometrical arrangements to some rather detailed descriptions of mechanisms of various aspects of the processes. Nevertheless, there remain today many unanswered questions. In the following the state of art of various aspects of boiling and condensation will be presented along with some of the significant unanswered questions. (auth)

18278 FLUID MODELING OF CRITICAL HEAT FLUX IN UNIFORMLY HEATED ANNULI. Ahmad, S. Y.; Groeneveld, D. C. (Atomic Energy of Canada, Chalk River, Ont.). Progr. Heat Mass Transfer; 6: 45-53(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Results of an experimental and analytical program to develop Freon-water modeling of critical heat flux in annular geometries are presented. Experimental critical heat flux data were obtained with Freon-12 over a wide range of pressure and mass flux. These were compared with water data using Ahmad's compensated distortion model. A critical heat flux correlation for annular geometries which is independent of fluid types was developed from the Freon data and subsequently applied to published water data. It was concluded that adequate modeling of critical heat flux in an annular geometry can be obtained provided the size of the model and prototype is identical. (auth)

18279 BURNOUT CONDITIONS FOR ROUND TUBES AT ELEVATED PRESSURES. Becker, K. M.; Djursing, D.; Lindberg, K.; Eklind, O.; Oesterdahl, C. (Royal Inst. of Tech., Stockholm). Progr. Heat Mass Transfer; 6: 55-73(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Burnout conditions for flow of boiling water in vertical tubes were studied experimentally in the following ranges of variables: dia, d, = 10 mm; heated length, L, = 2000, 3000 and 5000 mm; pressure, p, = 100, 120, 140, 160, 180 and 200 bar; inlet subcooling, Δt_i, = from 8 to 272°C; mass velocity, G, = from 156 to 7560 kg/m^2s; heat flux, q/A, = from 13 to 353 W/cm^2; and burnout steam quality, χ_{BO}, = from -0,3 to 1.0. The measurements were compared with the Tong, CISE and Macbeth burnout correlations, and it was found that for the pressure range studied, none of these correlations yield satisfactory predictions. However, the measurements were in very good agreement with the correlation by Peskov. Finally, a new burnout correlation has been derived for the high-pressure range. This correlation is in good agreement with the present results and with data from other sources. (auth)

18280 POST-BURNOUT HEAT TRANSFER IN HIGH PRESSURE STEAM-WATER MIXTURES IN A TUBE WITH COSINE HEAT FLUX DISTRIBUTION. Keeys, R. K. F.; Ralph, J. C.; Roberts, D. N. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Progr. Heat Mass Transfer; 6: 99-118(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Experimental results are reported on the propagation of dryout in vertical up-flow of steam and water in an electrically heated tube at a pressure of 6.9×10^6 N/m^2. The 1.27-cm bore, 3.66-m long tube was machined from Nimonic 75 to withstand the high post burnout temperatures and also to provide a material with a very small change of electrical resistivity with temperature. An axi-symmetrical heat flux distribution of approximately cosine form was obtained by machining of the tube wall. Measurements were made of local wall temperature as the tube was driven into steady dryout by gradual increase of input power. At mass velocities up to approximately 2.7×10^3 kg/s/m^2, the behavior of the system was well ordered, it being possible by small power increments (approximately 1%) to drive the steady state dryout front gradually upstream. Each power increment gave rise to a well-defined wall temperature versus length locus which showed no subsequent rewetting of the heated surface once dryout had occurred. At high mass velocity (> 2.7×10^3 kg/s/m^2), the dryout front became very sensitive to small power changes and first dryout zones appeared suddenly but stably more than 1 m

upstream of the tube outlet. Dryout zones were often short and rewetting occurred after only a few centimeters with no apparent dryout elsewhere. In some cases, however, two simultaneous dryout zones were observed. Measured dryout positions and steam quality were compared with those predicted by a local conditions hypothesis and by a hydrodynamic or boiling length concept. It was found that a hydrodynamic correlation of burnout was superior to the local conditions hypothesis. The burnout position was not predicted satisfactorily by either theory, particularly for the high mass velocities. The exact position depends on the increment of power applied which takes the tube into first dryout. (auth)

18281 PREDICTION OF TIME-DEPENDENT DIABATIC TWO-PHASE WATER FLOWS. Hancox, W. T. (Westinghouse Canada Ltd., Ont.); Nicoll, W. B. Progr. Heat Mass Transfer; 6: 119-135(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

An analytical technique is presented for the prediction of the oscillatory behavior of flow-boiling systems. The analysis is based on the cross-section averaged form of the mass, energy and momentum conservation laws. Constitutive laws, based on a local conditions hypothesis, have been developed to describe the effects of non-uniform void and velocity profiles, the vapor generation rate, and the wall shear stress. Predictions of steady flow axial void and pressure distributions are shown to be in good agreement with available data, as are predictions of void oscillation amplitude and phase lag for modulated heat flux data and conditions at the onset of sustained-flow oscillations for fixed pressure-drop channels. (auth)

18282 CHF DATA FROM FREON-11 FLOW FOR SCALING CHF IN WATER. Motley, F. E.; Cadek, F. F.; Cermak, J. O.; Tong, L. S.; Gouse, S. W. Jr.; Paul, F.; Purcupile, C. Prog. Heat Mass Transfer; 6: 137-153(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Freon-11 CHF (critical heat flux) data are presented which models water at high pressure in the subcooled region. These data were obtained from a sixteen-rod non-uniform heat-flux bundle. The heater rods were 8 ft in length and had a u sine u or cosine heat-flux shape. The data range reported includes: pressure from 160 to 515 psia, mass velocity from 1.5 to 4.0×10^6 lb/hr/ft^2, inlet temperature from 220 to 330°F, CHF from 0.4 to 1.2×10^5 Btu/hr/ft^2. The above pressure range is equivalent to water pressures between 1000 and 2700 psia in the subcooled region. In order to establish the scaling relationships, water CHF data was obtained using the same rod bundle and grid geometry over the following range of parameters: pressure from 1500 to 2400 psia, mass velocity from 2.0 to 3.5×10^6 lb/hr/ft^2, inlet temperature from 480 to 600°F, CHF from 0.5 to 1×10^6 Btu/hr/ft^2. Three different spacers were employed: simple support grid, mixing vane grid A, and mixing vane grid B. The Freon and water CHF results exhibit the same trends with respect to the above parameters. The axial location of CHF agreed in both Freon-11 and water in the majority of comparable runs. The results of these two series of tests were used to determine scaling factors to relate water and Freon-11. A scaling technique of matching CHF quality was used. The scaling factors were found to be a function of pressure. These scaling factors were then used to scale the Freon CHF results to equivalent water CHF. There is good agreement with the W-3 correlation predictions for various types of grids. (auth)

18283 TRANSPORT PHENOMENA AT THE LIQUID–VAPOR INTERFACE OF MERCURY USING A RADIOACTIVE TRACER. Wylie, K. F.; Brodkey, R. S. (Ohio State Univ., Columbus). Progr. Heat Mass Transfer; 6: 195-206(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

A unique experimental procedure is described which individually provides a determination of the condensation and evaporation coefficient under non-isothermal conditions of the liquid-vapor phases. Employing a radioactive mercury tracer it is demonstrated that the condensation and evaporation coefficients associated with a net condensation of a tagged mercury on the surface of its flowing (initially non-radioactive) liquid phase are equal and may be less than unity. Under the non-isothermal condition, examination of the liquid and vapor temperatures with a movable thermocouple probe demonstrated that the bulk vapor temperatures exist to within less than ten mean free path lengths of the liquid surface. (auth)

18284 AIR–WATER ANNULAR FLOW IN A HORIZONTAL TUBE. Butterworth, D. (Atomic Energy Research Establishment, Harwell, Eng.). Progr. Heat Mass Transfer; 6: 235-251 (1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Experiments were conducted on low-pressure, air–water, annular flow in a 31.8-mm ID horizontal tube. For two flow conditions and for two distances downstream of liquid injection, the film characteristics were measured as a function of circumferential position, and liquid entrainment measurements were made in the gas core. Large variations in these measurements with circumferential position were found but the variation with length was small. The total entrainment flow rates were estimated from the sampling studies and the film flow rates estimated from the film thickness measurements by using the Hewitt model. In evaluating the Hewitt model, it was assumed that the wall shear was constant around the perimeter of the tube. The sum of the calculated film flow rate and entrainment flow rates was found to be in good agreement with the input liquid flow despite the fact that the assumption of constant shear was of doubtful validity. The measurements were examined for compatibility with the various mechanisms which have been proposed for maintaining the film at the top of the tube. It was found that the results were compatible with the "secondary-flow" and "wave-spreading" mechanisms, but were incompatible with the "entrainment-deposition" mechanism. It was shown that surface tension can never be an important force (on its own) for maintaining annular flow, except perhaps in extremely small tubes. (auth)

18285 ROLE OF EXPERIMENTS IN TWO-PHASE SYSTEMS WITH PARTICULAR REFERENCE TO MEASUREMENT TECHNIQUES. Hewitt, G. F. (Atomic Energy Research Establishment, Harwell, Eng.). Progr. Heat Mass Transfer; 6: 295-343 (1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

The use of measurement techniques in two-phase flow systems and attempts to classify the various techniques according to their relevance in the development of the generalized subject of two-phase fluid flow are reviewed. The types of parameters studied are classified as follows: first-order parameters which are of direct relevance in design and can be divided into primary design factors such as pressure drop and heat-transfer coefficient and secondary design factors such as flow distribution and stability; second-order parameters in which one may classify time-averaged observations which are not of primary relevance in design, but which assist in the development and testing of analytical models of the system (Examples of this type of parameter would be liquid film thickness, radial mass flow distribution and particle size); and third-order parameters in which the time-varying nature of the parameter is important, examples being interfacial structure, velocity fluctuations and temperature fluctuations. Measurements of these parameters are aimed at providing a qualitative understanding of the system and in assisting in building up more detailed models. The modelling of two-phase systems and improvement of their performance is discussed. (auth)

18286 OUT-OF-PILE SUBCHANNEL MEASUREMENTS IN A NINE-ROD BUNDLE FOR WATER AT 1000 PSIA. Lahey, R. T. Jr.; Shiralkar, B. S.; Radcliffe, D. W.; Polomik, E. E. (General Electric Co., San Jose, CA). Progr. Heat Mass Transfer; 6: 345-363(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Measurements of the local mass flux and enthalpy distribution in a nine-rod bundle with geometrical parameters typical of a square-pitch boiling-water reactor fuel bundle are described. The method of isokinetic sampling was employed for various flow rate-heat flux combinations with both single- and two-phase exit conditions. The method consists of physically isolating the flow in individual subchannels near the test section exit by means of flow splitters. The flow rates in the representative sub channels are adjusted by means of flow control valves so as to maintain isokinetic conditions (i.e., a constant static pressure across the cross section just ahead of the flow splitters). These flow rates are then measured and the qualities calculated by calorimetry. Sampling measurements were performed for uniform heat flux over a six-foot heated length with both pin-type spacers (which cause minimum disturbance to the flow) and grid-type spacers. The effects of grid spacers on the redistribution of flow within the rod array were examined. Tests were also made with non-uniform heat fluxes. The data were checked for consistency by means of overall continuity balances for both mass and energy. Comparisons with existing subchannel computer codes (e.g. COBRA) show that these codes do not predict the two-phase results well in the geometry tested. In general, a tendency for the steam to migrate to the central, high-velocity region of the bundle was observed. Possible reasons for this discrepancy between the data and the predictions of present generation computer codes are discussed. (auth)

18287 COMBINED PHOTOGRAPHIC FILM THICKNESS AND TEMPERATURE TECHNIQUE FOR OBSERVING DRYOUT. Parsons, C. B. (Canadian Westinghouse, Hamilton, Ont.); Brundrett, E. Progr. Heat Mass Transfer; 6: 365-384(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Experiments designed to investigate the physical mechanisms of dryout at 6895 and 3448 kN/m^2 were carried out in the FLARE facility at the Chalk River Nuclear Laboratories of Atomic Energy of Canada Limited. The test section consisted of an electrically heated element located concentrically in a vertical shroud. An observation assembly consisting of three window ports was attached to the shroud such that the top 2 in. of the heater could be viewed. High-speed movies coupled with simultaneous surface temperatures and liquid-film thickness measurements were recorded. Very close agreement was found between the photographic, thermocouple and film-thickness data. Mass flow rates from 0.271 to 1.356 × 10^3 kg/s m^2 (0.2 to 1.0 × 10^6 lb/hr-ft^2) with heat fluxes of 0.315 to 1.577 × 10^6 W/m^2 (0.1 to 0.5 × 10^6 Btu/hr-ft^2) were investigated. (auth)

18288 DRAG COEFFICIENT FOR PARTICLES IN RAREFIED, LOW MACH-NUMBER FLOWS. Crowe, C. T. (Washington State Univ., Pullman); Babcock, W. R.; Willoughby, P. G. Progr. Heat Mass Transfer; 6: 419-431(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

A parameter essential to the quantitative analysis of two-phase flows is the drag coefficient of the condensed phase particles. A review of the published drag data reveals that no results are available in the important flow region delimited by Mach numbers less than 2 and Reynolds numbers less than 100. A microballistic range was developed and utilized to measure particle-drag forces in this flow region. The results, reduced in terms of a normalized drag coefficient, are correlated with other drag data available over a wide range of flow conditions. Finally, an algebraic equation which provides a good data fit for all Mach numbers and for Reynolds numbers less than the critical Reynolds number is presented. (auth)

18289 TEST OF SIMILARITY VARIABLE FOR DILUTE FLUID–SOLID HEAT TRANSFER. Brandon, C. A.; Grizzle, T. A. (Clemson Univ., SC). Progr. Heat Mass Transfer; 6: 475-486(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

The interaction of solid particles with turbulent fluid in the vicinity of vertical surfaces was studied. The heat transfer to air suspensions of glass microspheres flowing upward in a 51-mm dia pipe was measured. Glass microspheres with mean diameters of 50 μm, 70 μm, and 100 μm were used in concentrations < 0.0004 volume fractions solids. The pipe Reynolds number range was 20,000 to 62,000 based on the properties of air alone. Tests in a 25-mm diameter tube using 70 μm microsphere with a Reynolds number of 12,000 to a concentration of 0.0011 were made. A peak in the heat-transfer enhancement in the 51-mm tube was observed for a constant value of the product, $d_p(N_{Re})^{\frac{1}{2}}$, consistent with the previously reported fluid–solid interaction model involving the microscale of fluid turbulence. (auth)

18290 MECHANICS OF TWO-PHASE SYSTEMS. Batchelor, G. K. (Cambridge Univ., Eng.). Progr. Heat Mass Transfer; 6: 633-649(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Problems related to defining the mechanics of two-phase systems, i.e., the average dynamic properties of disordered mixtures of a general type, are discussed. Important types of two-phase systems are categorized as fluid in a solid matrix, gas dispersed in a liquid, solid or liquid particles dispersed in a gas, and solid or liquid particles dispersed in a liquid. General guidelines for future basic research on two-phase systems are presented in the hope that simple concepts for explaining the physics of two-phase systems can be developed. (LCL)

18291 TWO-PHASE TWO- AND ONE-COMPONENT CRITICAL FLOWS WITH THE VARIABLE SLIP MODEL. Giot, M.; Fritte, A. (Catholic Univ., Louvain). Progr. Heat Mass Transfer; 6: 651-670(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

For describing two-phase one-component annular flows with thermodynamic equilibrium in constant cross-section pipes, a system of four differential equations must be solved by a step-by-step procedure. It is shown that this system must include one continuity equation, two momentum equations, and one energy equation. The critical flow condition is given by the vanishing condition of a fourth-order determinant. At given pressure and quality, this condition can be presented as a relation between critical mass-velocity and slip-ratio. An entropy balance equation is deduced from the other balance equations by means of the second principle of thermodynamics and it is shown that it can be used to derive the same critical flow condition. This variable slip model exhibits the increase of critical flow-rates with decreasing slip ratios occurring experimentally when decreasing the L/D parameter. The hypothesis of thermal equilibrium may be avoided in order to include jet flows which occur in short pipes. This requires an additional heat-balance equation. The critical flow conditions are also determined for two-component flows with separated phases with or without thermal equilibrium. (auth)

18292 SLUG EJECTION OF FREON-113 FROM A VERTICAL CHANNEL WITH NONUNIFORM INITIAL TEMPERATURE PROFILES. Ford, W. D. (American Oil Co., Whiting, IN); Bankoff, S. G.; Fauske, H. K. Progr. Heat Mass Transfer; 6: 685-700 (1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

Experimental data, ranging in initial superheat from 30° to 130°F, were obtained for both the bubble growth and collapse of Freon-113 in constant-diameter, vertical channels with nonuniform initial temperature profiles. In addition, measurements of the void fraction during the expulsion process were made. The bubble growth was initiated by either rapid depressurization of the test section or pulsing an electrode following a slow depressurization. An analysis is given in which the energy and momentum equations are coupled numerically. The energy equation accounts for not only the energy transported across the upper and lower liquid–vapor interfaces, but also that transported across the wall film–vapor interface. In computing the energy contribution of the wall film, a thin thermal boundary layer was assumed to exist, whose thickness as a function of exposure time and position along the vapor space was taken into account. The agreement between the experimental data and the coupled numerical solution to the energy and momentum equations was found to be good. (auth)

18293 HEAT-TRANSFER POTENTIAL OF LIQUID-GAS SPRAY FLOWS. Scherberg, M. G.; Wright, H. E.; Elrod, W. C. (Wright-Patterson AFB, OH). Progr. Heat Mass Transfer; 6: 739-752(1972).

From international symposium on two-phase systems; Haifa, Israel (29 Aug 1971). See CONF-710836-.

The heat-transfer characteristics for forced convection of a two-phase air–water-spray flow over three geometric shapes under conditions comparable to the upstream stages of a heat-exchanger bank were investigated. With a ratio of water spray to air mass flow less than 0.1, the average heat transfer is increased at least an order of magnitude in comparison to that for air flow alone. The heat-transfer amplification is limited to that region of the geometric shape covered by a liquid film and a very large increase is obtained at the forward stagnation point. Data presented show the enhancement of heat transfer from a right circular cylinder by the addition of water spray to the air stream. In addition, improvements of heat transfer obtained with the two-phase flow by considering an elliptical cylinder and an extended bluff body which permit an increase in the percentage of total surface area covered by a liquid film are presented. The interaction of the liquid droplets with the liquid film on the heated surface was investigated to gain a more complete understanding of the heat-transfer amplification process. (auth)

18294 TWO-PHASE ANNULAR FLOW: PREDICTION OF FILM THICKNESS. Sarma, P. V. S. C.; Sarma, P. K.; Venkata Apparao, K. (Andhra Univ., Waltair, India). Indian J. Technol.; 11: No. 5, 199-201(May 1973).

An analytical expression for liquid holdup for two-phase annular flow conditions is derived. A comparison of the results of analysis with some of the available experimental data revealed good agreement. (auth)

18295 IMPROVEMENTS IN TUBULAR HEAT EXCHANGERS. Hayden, O. (to United Kingdom Atomic Energy Authority). British Patent 1,336,555. 7 Nov 1973. Filed date 2 Apr 1970. 5p.

Reference is made to "tube-in-shell" types of heat exchangers. A problem arises in the use of such heat exchangers as steam generators in liquid metal cooled reactors. If a leak occurs in one of the heat exchanger tubes high pressure water or steam issuing through the leak will react with the sodium passing through the shell to form a highly erosive jet that can cut through adjacent tubes. Although means may be provided for detection of a leaking tube and for shut down of feed water to the heat exchanger, this takes time and extensive damage is likely to occur. In the system

described a plate is provided, penetrated by the tubes with clearance, and located so as to act as a barrier against an erosive jet from any one tube. Several alternative constructions are described. (UK)

18296 EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO AN AIR–WATER FLOW. Kosorotov, M. A. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 12, 91-92(Dec 1972).

Translated from Teploenergetika; 19: No. 12, 63-64(1972).

The coefficient of heat transfer from a wall to a gas–liquid flow can substantially exceed the coefficient of heat transfer to a flow of pure liquid. The known experimental data on heat transfer to gas–liquid media are inconsistent and to a large extent depend on the nature of the flow, the flow regimes, the gas flowrates, the physical properties of the liquid, the channel dimensions, and other factors. The results of an experimental investigation into heat transfer to a two-component flow of water and air in a horizontal Cr18Ni9Ti steel tube 18 mm in internal diameter and 1.5 m long. A Nichrome heater was used to heat the tube. The power supplied to the heater was measured by instruments of 0.5 class accuracy. To prevent loss of heat the working section of the tube was carefully insulated. The temperatures of the mixture at the inlet and outlet of the working section were measured by thermocouples in the flow. The temperature of the tube wall was measured by nine chromel-copel thermocouples, fastened to the outer surface of the tube wall. To measure heat leakage, thermocouples were also placed on the surface and within the layer of the thermal insulation. The measured temperatures were recorded by an M198 millivoltmicroampere meter of class I accuracy. A two-phase nozzle was used to provide an air–water flow; at the nozzle inlet air and water were supplied at the same pressure. The air and water flowrates were measured by differential manometers, determining the pressure drops over orifice plates installed in the flow lines; the flowrates were recorded. (TFD)

Materials Testing

18297 (AECL-4606, pp 5-9) EDDY CURRENT INSPECTION OF FERROMAGNETIC MONEL TUBES. Cecco, V. S. (Chalk River Nuclear Labs., Ont.). Win 1973.

The eddy current method is commonly used for inspecting metal tubes during manufacturing. However, in-service inspection because of inherent magnetic "noise" of ferromagnetic materials has been limited to non-ferromagnetic tubes. Both Douglas Point and Pickering generating stations have steam generators with ferromagnetic (Monel-400) tubes. A recently invented eddy current probe made possible nondestructive in-situ testing of the Monel-400 tubes. (auth)

18298 (AECL-4606, pp 13-15) SOME ASPECTS OF MECHANICAL RELIABILITY. Wolfe, W. A. (Chalk River Nuclear Labs., Ont.). Win 1973.

In mechanical devices, components are often subject to repeated loads of a given distribution. Care should be exercised in the formulation of the reliability of the component in this situation. A method of calculating reliability is given. (TFD)

18299 (RFP-2125) FEASIBILITY OF EDDY CURRENT MEASUREMENT OF FERRITE CONTENT IN STAINLESS STEEL WELDS. Lassahn, G. D.; Moment, R. L. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 17 Dec 1973. Contract AT(29-1)-1106. 10p. Dep. NTIS $4.00.

A phase-sensitive eddy current system was used to measure the presence of ferrite in an austenitic stainless steel matrix. Measurements were made on pressed powder specimens and on a weld in Type 304L stainless steel. The data obtained showed that small amounts of ferrite, on the order of 1 to 3%, could easily be detected. Variation in ferrite with position within the weld was also detected with good reproducibility. Absolute values for the ferrite content were not obtained as accurate standards for calibration were not available. (auth)

18300 (RFP-2139) LAMB-WAVE INSPECTION OF WELDS IN STAINLESS STEEL TUBES. Schrick, G. W. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 26 Dec 1973. Contract AT(29-1)-1106. 7p. Dep. NTIS $4.00.

An ultrasonic Lamb-wave inspection technique was developed for use in inspecting the gas tungsten arc (GTA) welds in small diameter stainless steel tubes for lack of penetration. The particular technique was employed because of the ability to introduce the sound into the material a distance from the weld. A conventional shear-wave technique was tried without success. (auth)

18301 EDDY CURRENT TESTING OF REACTOR COMPONENTS. Foerster, F.; Stumm, W. (Institut Dr. Foerster, Reutlingen, Ger.). Atomwirt., Atomtech.; 18: No. 12, 576-581 (Dec 1973). (In German).

In the last few years electromagnetic methods, also known as eddy current methods, have been increasingly applied in the nondestructive testing of reactor components. The testing may be carried out in two ways: using energy reflection with the transmitter and receiver on the same side of the material to be examined and using transmitted energy with the transmitter and receiver on opposite sides. The most important arrangements are described. In the testing of tubes and rods, they are most frequently passed through a coil which works by energy reflection. If the transmitter and receiver coil system is inserted inside the tube, the inner surface is preferentially tested. The test system is shot into the tube by compressed air and withdrawn by a cable so that internal cracks and corrosion spots on the inner and outer wall are recorded. The test velocity may be increased if the tube is moved axially and the probes are moved circumferentially around the tube in rotating heads without actually touching the tube. Eddy current techniques using medium and high test frequencies and with reflection and transmission systems permit the detection of material inhomogeneities with dimensions down to 20 μm. (GE)

18302 STATUS OF NONDESTRUCTIVE MATERIALS TESTING. Munc[illegible]y, E. (Bundesanstalt fuer Materialpruefug, Berlin). Amts-Mitteilungsbl. Bundesanst. Materialpruef.; 2: No. 3, 114-121(1972). (In German).

From general meeting of the Deutsche Gesellschaft fuer Metallkunde; Lausanne, Switzerland (4 Jun 1971).

The present status of the nondestructive material testing of work pieces or materials in iron ore processing is discussed. Surface testing processes, ultrasonic, and x-ray and gamma-ray radiation tests, known and highly developed do by no means give, in every case, sufficient reliable and quantitative data on the presently found faults. Color, neutron radiography, and neutron activation analysis are briefly mentioned as these methods are seldom used in practice. (GE)

18303 IMPROVEMENTS IN NONDESTRUCTIVE TESTING METHODS USED IN THE MECHANIC INDUSTRY. Mater. Nouv. Tech. Mond.; No. 200-202, vp(Apr 1972). (In French).

The earliest nondestructive testing methods are reviewed together with classical methods, e.g., spark testing, sweating, measurement of the hardness or microhardness; spectrography with or without metallography, magnetoscopy, radiography and gammagraphy; and ultrasound, electromagnetic induction, infrared thermal control. The latest nondestructive testing methods are discussed, e.g., neutron radiography, control using a betatron, control using nematic, sinectic, and cholesteric crystals. (FR)

18304 HIGH ENERGY RADIOGRAPHY: A NEW TECHNIQUE IN THE DEVELOPMENT OF EFFICIENCY AND INTEGRITY IN AERO GAS-TURBINE ENGINES. Pullen, D. A. W. (Atomic Energy Research Establishment, Harwell, Eng.). Mater. Eval.; 32: No. 2, 25-30(Feb 1974).

Engineers engaged in the development of efficiency and integrity in aero gas turbines require accurate knowledge of dynamic conditions within the engine to enable them to modify and improve the design. The ability to see and measure seal clearances between rotating and static components and the position and shape of various static components in a full range of static and dynamic engine conditions is an extremely valuable asset to engine development and design staff. Radiography is now being widely used in the United Kingdom for this purpose. The use of a linear accelerator with its great output of high energy x rays, has, for the first time enabled radiologists to produce quality radiographs within the demanding exposure conditions required for satisfactory results. The various parameters which must be adhered to in order to obtain optimized results are described. (auth)

Nuclear Explosions

Refer also to abstracts 18060, 18271, 18330, 18401, and 18511–18519.

18305 (CEA-R-4519) PHYSICOCHEMICAL BEHAVIOR OF A CAVITY PRODUCED BY AN UNDERGROUND NUCLEAR EXPLOSION. Humbert-Droz, C.; Collin, M.; Frey, A. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Dec 1973. 27p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

This study of an underground nuclear explosion has the objectives of providing a phenomenological description and the prediction of radiochemical behavior. Two chemical equilibrium systems for the macroconstituents and the microconstituents of

the geological material are considered in conjunction with the heat equations at different levels. In this way the variations in pressure and temperature of the gas can be studied together with the lava in the cavity and the distribution of radioactive products in the different phases. (auth)

18306 (UCID-15801) MAGREC PROJECT: DEVELOPMENT OF A MAGNETIC RECORDING SYSTEM AND DEVICE FOR FAST TRANSIENTS IN NUCLEAR DIAGNOSTICS. Fischer-Colbrie, E.; Condas, G.; Hsieh, E.; Kippenhan, D.; Rufer, R.; Wichner, R.; Winslow, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Dec 1970. 59p. Dep. NTIS $5.00.

The development of methods and hardware to record fast transients on magnetic materials, particularly applicable to prompt diagnostics of nuclear events, is described. The basic recording and reading techniques are described as well as recent advances in materials and hardware. (auth)

18307 (UCID-16436) DATA AND RESULTS, NUCLEAR CHIMNEY PERMEABILITY–TEST 3. Snoeberger, D. F.; Morris, C. J.; Baker, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jan 1974. Contract W-7405-eng-48. 7p. Dep. NTIS $3.00.

Tests were conducted at a third nuclear chimney site in alluvium at the Nevada Test Site. The indicated value of pressure diffusivity is in the range of 0.5 to 1.0 m^2/s. Previously described methods based on atmospheric pressure change were used to obtain an improved fit of calculated to measured pressure-time curves by superposition analysis. (auth)

18308 (UCRL-51460) TRILIN: A COMPUTER ANALYSIS OF THE TRANSIENT RESPONSE OF ELASTIC STRUCTURES. Miller, A. B.; Weston, A. M.; Hallquist, J. O.; Bernreuter, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Oct 1973. Contract W-7405-eng-48. 42p. Dep. NTIS $5.45.

The computer code TRILIN employs a force method that uses prismatic beam-type elements and discrete masses for the analysis of the transient response of linearly elastic, three-dimensional, frame-type structures subjected to arbitrary loading conditions. Each beam element is capable of resisting tension, bending, and torsion. A global stiffness matrix is obtained by inverting the flexibility relationships. Modal superposition is used to solve the governing equations. (auth)

18309 MULTIPLE DISCRIMINANT SCREENING PROCEDURE FOR TEST BAN VERIFICATION. Basham, P. W.; Anglin, F. M. Nature (London); 246: No. 5434-5435, 474-476 (Dec 1973).

Detailed consideration is given to utilization of earthquake-nuclear explosion seismological discrimination experience in a national operational verification procedure, but it is emphasized that such consideration in relation to clandestine underground nuclear explosions, or evasion tactics in general, is futile until all natural seismic activity can be identified down to the equivalent explosion yield. Thus the operational procedure becomes an earthquake screening process that can be simulation tested in advance of a Test Ban Treaty. The seismic region chosen is a major part of Eurasia and the monitoring nation is assumed to be Canada, although with the data exchange procedures inherent in the scheme it could be any nation. The seismic events considered are taken from the MIT Lincoln Laboratory bulletin, and these are subjected to three types of earthquake screening: (1) those with epicentres at sea, (2) those with focal depths greater than the maximum feasible drilling depth, and (3) those that are earthquake-like by wave discrimination criteria. In order to screen events using discrimination criteria a formal two-group discrimination analysis is used. (UK)

Protective Structures and Equipment

18310 (AAEC/LIB/Bib-401) CHARCOAL FILTERS IN VENTILATION SYSTEMS FOR THE REMOVAL OF IODINE, KRYPTON, AND XENON, AND THEIR RADIOACTIVE FORMS. A Bibliography 1962–1972. Geue, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1973. 70p. Dep. NTIS (U. S. Sales Only) $5.50.

Two-hundred and thirty-nine references to literature on charcoal filter systems for removal of iodine, krypton, and xenon from gas streams are presented. The references were taken from Nuclear Science Abstracts (NSA), covering the period from Jan. 1962 to July 1973. An abstract number is cited for each reference. (TFD)

18311 (LA-5470-PR) RESPIRATOR STUDIES FOR THE AEC DIVISION OF OPERATIONAL SAFETY. Progress Report, January 1–June 30, 1973. Hyatt, E. C.; Held, B. J.; Bevis, D. J.; Moore, T. O. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1973. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

The LASL Respirator Research and Development Section, Industrial Hygiene Group, performed studies and conducted training for the Division of Operational Safety (DOS) during the second half of FY 1973. The major work involved development and initiation of a training course for AEC contractors and AEC personnel; writing a Respirator Manual for use by the AEC and their contractors; providing consulting services for the DOS and contractors; man testing several respirators; and holding a three-day Respirator Symposium jointly sponsored by the DOS, the Directorate of Regulatory Standards, and LASL. (auth)

18312 (REG/G-3.9(6-73)) CONCRETE RADIATION SHIELDS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 2p. DRS Washington, DC Free.

Concrete radiation shields can be installed in nuclear facilities such as hot laboratories, radiochemical plants, experimental facilities, and nuclear fuel fabrication plants to provide a barrier between personnel and radiation sources for the purpose of reducing doses of ionizing radiation received by personnel to as low as practicable levels. This guide describes practices for the construction of concrete radiation shielding structures for such nuclear facilities, which are acceptable to the Regulatory staff as methods of complying, in part, with Commission regulations with regard to reducing radiation exposures. Much of the information included may be applicable to shielding structures for reactors and other nuclear and nonnuclear facilities which require concrete radiation shields. (TFD)

18313 SHIELDING CELL FACILITY FOR THE DEVELOPMENT OF REPROCESSING PROCEDURES FOR IRRADIATED FUELS. Beone, G. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 19: No. 1, 21-28 (Jan 1973). (In Italian). (RT/CHI(73)3).

A system of hot cells now being completed at the Casaccia Center is described in detail. (auth)

Safety Engineering

Refer also to abstract 18265.

18314 (AECL-4606) AECL RESEARCH AND DEVELOPMENT IN ENGINEERING. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Win 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

Separate abstracts have been prepared for each of the five papers included. (TFD)

For abstracts of individual papers see: 18297, 18298, 18537, 20050, and 20265.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 18260 and 18476.

18315 URANIUM AND THORIUM IN KIMBERLITES OF SIBERIA. Lutts, B. G.; Mineeva, I. G. (Inst. of Physics of the Earth, Moscow). Geokhimiya; No. 11, 1721-1724(Nov 1973). (In Russian).

As a result of the determination of Th and U in kimberlites of Siberia it was shown that in comparison with ultrabasic and basic rocks the kimberlites are characterized by an increased concentration of Th and U, but the Th/U ratio is characterized by abnormal values. This characteristic can be used in the search for kimberlite solids. (tr-auth)

18316 URANIUM AND BORON DISTRIBUTIONS IN SOME OCEANIC ULTRAMAFIC ROCKS. Seitz, M. G. (Carnegie Institution of Washington, DC); Hart, S. R. Earth Planet. Sci. Lett.; 21: No. 1, 97-107(Dec 1973).

From mica fission-track maps the serpentinized and weathered portions of four ultramafic rocks from oceanic ridge systems contained 0.5 to 2.4 ppM U compared to only 2.5 ppB in clinopyroxene, 0.6 ppB in chromite and < 7.0 ppB in olivine. Orthopyroxene grains contained 0.4 ppB U which is three orders of magnitude lower than had previously been reported. Long thin tracks from (n,α) reactions with boron were recorded in cellulose nitrate plastic and were counted like fission tracks. The track density from boron was 2×10^4 times higher than that from uranium fission alone. Boron in serpentine was variable on a 50-μm scale attaining 155 ppM concentrations. Orthopyroxene grains, in contrast, had maximum concentrations of 0.8 ppM. Most of the uranium and boron in the rocks is believed to have been introduced during serpentinization. From known crystal-melt partitioning ratios the uranium and boron distributions are consistent with the ultramafic rocks being cumulates or residues from partial melting events. (auth)

18317 URANIUM AND HEAVY METALS IN PERMIAN SANDSTONES NEAR BOLZANO (NORTHERN ITALY). Brondi, A.; Carrara, C.; Polizzano, C. (CNEN, Rome). pp 65-77 of Ores in Sediments. Amstutz, G. C. (ed.). Berlin; Springer-Verlag (1973).

The discovery of sedimentary galena concentrations in Permian sandstones of Alto Adige (Northern Italy) by means of mineralogical alluvial prospection promoted wide scale exploration in the whole basin of Bolzano. This search confirmed the wide extent and importance of lead mineralization. A general and synthetic description of the first discovery and a short presentation of other mineralizations found both in the Permian sandstones and in the "Tregiovo Formation" are reported. The complexity of the mineralizations will be studied by means of paleogeographic criteria in the light of the general sedimentological development of the Permian basin of Alto Adige. The aim of the present work is simply to make some details known and to point out the interest in this type of mineralization in a region which, up to now, has been intensively studied from a minerogenetic point of view. (auth)

Radioactive Effluents

Refer also to abstracts 18225–18227.

18318 (BNWL-CC-1032) FIELD EVALUATION OF GROUND DISPOSAL OF REACTOR EFFLUENT: 1301-N CRIB. Eliason, J. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 8 Feb 1967. Contract AT(45-1)-1830. 22p. Dep. NTIS $3.25.

The minimum travel time of 79 days observed for ^3H at the point of maximum flow along the riverbank spring-front gives a minimum decay time that can be also applied to other radioisotopes discharged to the crib. Actual travel times of isotopes discharged to the site are dependent on the interaction of the isotopes with the sediments (ion-exchange, chemical, adsorption, etc.). A travel time of 101 days observed for ^{131}I is an indication of the dependence of actual migration rates on the isotope's interaction with the soil materials. The interaction of most isotopes with sediments is significantly greater than that of iodine. Therefore, most isotopes will have much longer travel times. Significant quantities of the waste appear to be flowing northeast from the site into the Columbia River below 100-D Area. This would increase the length of flow path and travel times to the river by a factor of 10. Estimates of the distribution of long-lived isotopes at the site are based on laboratory measurements. Field evaluations of the actual distributions of long-lived isotopes are in progress. This study involves drilling and sampling of the sediments in and near the crib. Analyses of radiocontaminants in these samples will provide an even more accurate field-scale evaluation of disposal at the 1301-N crib than has heretofore been made. (auth)

18319 (JUL-997-RG) IODINE RELEASE FROM NUCLEAR POWER PLANTS AND REPROCESSING PLANTS AS WELL AS THE ESTIMATION OF THE CONTAMINATION OF THE ENVIRONMENT IN THE FUTURE. Bonka, H.; Bruessermann, K. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Aug 1973. 72p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

Contamination of the environment in the Federal Republic of Germany due to radioactive iodine released from nuclear power stations and reprocessing plants for the next century is considered. Based on present iodine emission rates the results indicate an upper limit of the installed power for light water reactors at one location. In contrast to the light water reactors, high temperature reactors and liquid metal fast breeders emit iodine in small quantities, only. Near nuclear power reactors ^{131}I contributes about 80% and near reprocessing plants ^{129}I contributes about 80% to the thyroid dose. In the next century no limitations in building new nuclear power plants and reprocessing plants are to be expected with regard to local aspects of radioactive iodine. The radiation dose of globally distributed iodine should be several orders of magnitude lower than the maximum dose near nuclear facilities. (auth)

18320 ENVIRONMENTAL PROTECTION IN A NUCLEAR POWER PROGRAMME. Crancher, D. W.; Higson, D. J. (Australian Atomic Energy Commission, Lucas Heights). Proc. Roy. Aust. Chem. Inst.; 40: No. 11, 321-327(Nov 1973).

The biological effects of radioactivity, the sources of possible radioactive pollutants arising from the various stages in the nuclear industry, and the control measures adopted to prevent inadvertent release of these pollutants into the environment are discussed. (AT)

18321 PLANTS AS BIOINDICATORS OF THE CONTAMINATION OF A RIVER BY THE EFFLUENTS OF A PWR NUCLEAR POWER STATION. Assessment of the Radioactive Releases of the Sena Reactor Through Aquatic and Ripicolous Plants of the River Meuse. Kirchmann, R. (CEN, Mol, Belgium); Lambinon, J. Bull. Soc. Roy. Bot. Belg.; 106: 187-201(1973). (In French).

In the course of a general program of radiological investigation of some sites for location of nuclear plants, various aquatic and riparian plants were tested with the view of using them as bioindicators of the contamination of the water and of its development with time. The study comprised first the comparison of various plant species and shows notably the difficulties of using helophytes as biological indicators; it results in the choice of aquatic mosses, in particular of Cinclidotus danubicus, as bioindicator. The response of this species at a given point, situated about 15 km downstream from the plant, is analyzed for a period of more than three years. Finally, the levels of contamination of the indicator at various points along the course of the Meuse are compared at two-year intervals; the results are discussed in relation especially to the levels of activity of the wastes since 1969. (tr-auth)

18322 ENVIRONMENTAL ASPECTS OF NUCLEAR POWER. Beattie, J. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). Atmos. Environ.; 7: No. 12, 1205-1211(Dec 1973).

From atmosphere and man; London, Eng. (3 Jan 1973).

About half of the U. K.'s electrical generating capacity is likely to be nuclear by the end of this century. With this in mind, the gaseous effluents from nuclear reactors and plants are reviewed in this paper. Uranium mining and fuel manufacture produce no significant gaseous wastes. Nuclear Power reactors and fuel reprocessing plants produce small but significant quantities of radioactive gases which are discharged under controlled conditions. There are no long-term widespread or even moderately significant effects from gaseous discharges from reactors. Krypton 85 and tritium in spent fuel are liberated mainly at the reprocessing plants, and an International Group has concluded that various factors make it desirable to plan for the installation of krypton removal equipment in reprocessing plants during the 1980's. When this action has been taken, it may then be necessary to give consideration to reducing tritium discharges. Gaseous effluent discharges to the atmosphere from nuclear reactors and plants are under good control and do

not raise issues now or in the future which are not solved or capable of solution when required. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 18382, 18384, 18393, 18472, 19020, and 20216.

18323 (RISO-291) ENVIRONMENTAL RADIOACTIVITY IN DENMARK IN 1972. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jun 1973. 99p. Dep. NTIS (U. S. Sales Only) $7.00.

Measurements of fallout radioactivity in Denmark in 1972 are presented. ^{90}Sr was determined in samples from all over the country of precipitation, soil, ground water, sea water, grass, dried milk, fresh milk, grain, bread, potatoes, vegetables, fruit, total diet, drinking water, and human bone. Futhermore ^{90}Sr was determined in local samples of air, rain water, grass, sea plants, fish, and meat. Cesium-137 was determined in soil, sea water, milk, grain products, potatoes, vegetables, fruit, total diet, and meat, and ^{137}Cs was measured by wholebody counting in persons from a control group at Risø. Estimates of the mean contents of radiostrontium and radiocesium in the human diet in Denmark in 1972 are given. The γ-background was measured regularly at locations around Risø, at ten of the State experimental farms and in an area in Zealand, one in Jutland where future nuclear power plants might be located, and along the shores of the Great Belt. Finally regular surveys of environmental samples from the Risø area are included. (auth)

18324 (RISO-293) ENVIRONMENTAL RADIOACTIVITY IN GREENLAND IN 1972. Aarkrog, A.; Lippert, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jul 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Measurements of fallout radioactivity in Greenland in 1972 are reported. Strontium-90 (and cesium-137 in most instances) was determined in samples of precipitation, sea water, vegetation, animals, and drinking water. Estimates of the mean contents of ^{90}Sr and ^{137}Cs in the human diet in Greenland in 1972 are given. (auth)

18325 CONCENTRATION OF ^{226}Ra IN THE REGION OF KATOWICE. Grosman, A.; Kwapulinski, J.; Lukasik, K. (Instytut Gospodarki Komunalnej, Chorzow, Poland). Nukleonika; 18: No. 10, 495-499(1973). (In Polish).

Results of concentration measurements of ^{226}Ra in the peryphyton, plants, rainfall, water and suspended matter are presented. In the regions characterized with the greater dustiness the concentration of ^{226}Ra in the rainfall was higher than in those with the lower dustiness. (auth)

18326 DATA. Section IV. Environmental Levels of Radioactivity at Atomic Energy Commission Installations. Radiat. Data Rep.; 14: No. 11, 706-725(Nov 1973).

Data are presented on the levels of radioactivity in environmental samples collected at the Los Alamos Scientific Laboratory during 1971. Data are included on the content of ^{238}Pu in soil samples and surface waters and the content of tritium in surface air. Areas with trace contamination by Pu and β emitters were found in canyons now used or previously used for the disposal of liquid effluents. (CH)

18327 TRITIUM INSTRUMENTATION FOR ENVIRONMENTAL AND OCCUPATIONAL MONITORING. A Review. Budnitz, R. J. (Univ. of California, Berkeley). Health Phys.; 26: No. 2, 165-178 (Feb 1974).

The techniques developed for measuring tritium in various media are reviewed. The main emphasis is on measurements for surveillance and protection in environmental and occupational situations. Tritium measurements in specialized research applications are not treated in detail. Overviews are first provided of the physical characteristics of tritium; of the sources of and typical levels of tritium concentrations in the natural environment; and of the radiation protection guides. The various measurement techniques are then discussed. (auth)

18328 RADON-222 AND ITS DAUGHTERS. A Review of Instrumentation for Occupational and Environmental Monitoring. Budnitz, R. J. (Univ. of California, Berkeley). Health Phys.; 26: No. 2, 145-163(Feb 1974).

The techniques which have been developed for measuring ^{222}Rn and its daughters in various media are reviewed. The main emphasis is on measurements for surveillance and protection in occupational and environmental situations. Measurements in specialized research applications are not treated in detail. Overviews are first provided of the physical characteristics of ^{222}Rn and its daughters; of the sources of and typical levels of concentrations in the natural environment and in occupational exposures; and of the radiation guides. The various measurement techniques are then discussed. (auth)

18329 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 12, 762-779(Dec 1973).

Environmental monitoring near US nuclear facilities, specifically, the National Reactor Testing Station and the Oak Ridge area, is presented. Tabulated data from Jan. through Dec. 1970 measurements at NRTS include: radioactivity in surface air, surface waters, and drinking water; ^{137}Cs, ^{131}I, and ^{90}Sr content in milk; and ^{90}Sr content in wheat. For the Oak Ridge area, tabulated data from July to Dec. 1970 measurements are presented for the gross β-activity in surface air, gross α-activity of particulates in air, ^{131}I and ^{90}Sr in milk, and radioisotopes content in Clinch River. Power reactors in the US as of 30 Sept. 1973 are listed by site, name, capacity, owner, and expected commercial operation date. (LCL)

18330 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 1, 30-36(Jan 1974).

Monitoring during 1971 in the environs of the Knolls Atomic Power Laboratory-Windsor (Conn.) Site and the Portsmouth Area Gaseous Diffusion Plant (Ohio) is discussed. Tabulated data are presented on the gross gamma concentration in Farmington river water and bottom sediment samples and on the radioactivity of surface air and water samples near the Portsmouth plant. Detection of an underground nuclear explosion detonated on 14 Dec. 1973 in the USSR is reported. (LCL)

18331 FAST METHODS OF ENVIRONMENT RADIOACTIVITY MEASUREMENT. Pensko, J. (Inst. of Nuclear Research, Warsaw). Postepy Fiz. Med.; 7: No. 1, 33-42(1972). (In Polish).

Papers read at an international symposium devoted fast methods of the radioactivity measurement of the environment surrounding the human being are reviewed. The symposium was held July 1971 in Neuherberg near Munich. (auth)

18332 APPLICATION OF NUCLEAR TECHNIQUES IN ENVIRONMENTAL PROTECTION. Antoni, F.; Bartfai Szabo, L.; Dorogi, L.; Erdelyszky, Z.; Feher, L.; Kelemen, L.; Kovacs, J.; Pavlik, O. (Semmelweis Orvostudomanyi Egyetem Orvosi Vegytani Intezete, Budapest). Izotoptechnika; 16: No. 12, 639-653(Dec 1973). (In Hungarian).

Nuclear techniques for the determination of contamination of air, soil, plants, foods and water, and for the control of their decontamination are discussed. (auth)

18333 CRITERIA FOR SITING, DESIGN, AND OPERATION OF PLANTS FOR THE MANUFACTURE OF MIXED OXIDE (U–Pu) FUELS. Pittsburgh; Instrument Society of America (1973). 47p. (ANSI-N-46-4).

A proposal, or draft standard, is presented for defining conditions important to safety, nuclear materials safeguards, and environmental protection which must be met in the siting, design, operation, and decommissioning of facilities for manufacturing mixed oxide fuel using nonpyrophoric forms of U and Pu. (LCL)

Atmosphere

Refer also to abstract 18066.

18334 (BNL-18505) INTERCOMPARISON OF AIRBORNE TRITIUM VAPOR SAMPLING METHODS AT BROOKHAVEN NATIONAL LABORATORY. Marmaro, G. M. (Brookhaven National Lab., Upton, N. Y. (USA)). Dec 1973. 66p. Dep. NTIS $5.50.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

An intercomparison study was conducted on six tritium vapor samplers. Four of these were airflow samplers: a molecular sieve tube, a silica gel tube, a mixed silica gel tube (a column of clear silica gel mixed with 10% color-indicating silica gel), and two series-connected frit bubblers. The remaining two were non-airflow samplers: a thermoelectric cooler and an open petri dish containing clear silica gel mixed with 10% color-indicating silica gel. The analytical method associated with the mixed silica gel tube and the petri dish samplers incorporated a technique for direct counting of exposed silica gel in a liquid scintillation spectrometer. The usual liquid scintillation technique was employed with all other analyses. An experimental system was devised whereby known concentrations of tritium vapor in air could be produced and which would permit simultaneous testing of the samplers. Air concentrations ranging from 7.51×10^{-9} μCi/cc to 1.30×10^{-3} μCi/cc were generated. The average response of most of the samplers generally indicated good accuracy, but the

accompanying standard deviations demonstrated a lack of consistency and reproduceability. The mean sampled-to-generated air concentration ratios, for all samplers except the silica gel tube, ranged from 0.83 to 1.07, while the associated standard deviations ranged from ±0.22 to ±0.48. Problems encountered during this study indicate that erroneous flowmeter response can be a major source of error for airflow-type samplers. Results have shown that the direct counting technique is generally satisfactory. (auth)

18335 (COO-1340-37) DISPERSION OF RADIOACTIVE MATERIAL ON SMALL, MESO-, AND GLOBAL SCALES. Reiter, E. R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). 1973. Contract AT(11-1)-1340. 48p. (CONF-731110-6). Dep. NTIS $4.50.

From symposium on the physical behavior of radioactive contaminants in the atmosphere; Vienna, Austria (12 Nov 1973).

A brief review is given of the concept of "scales" of atmospheric motions and their effect on turbulent diffusion. Mesoscale transport processes in the planetary boundary layer and the exchange between this layer and the rest of the atmosphere are described. Global transport processes, the exchange of air between stratosphere and troposphere, and stratospheric residence times of nuclear debris are summarized. (auth)

18336 (NOAA-TM-ERL-ARL-40) ATMOSPHERIC TRANSPORT AND DISPERSION OF POLLUTANTS AND RELATED METEOROLOGICAL STUDIES, JULY 1971–JUNE 1972. Annual Progress Report. List, R. J. (ed.). (National Oceanic and Atmospheric Administration, Silver Spring, Md. (USA). Air Resources Labs.). Mar 1973. 53p. Dep. NTIS $4.75.

Predictions of future and past carbon dioxide (CO_2) concentrations were derived from a simple multireservoir exchange model: stratosphere, troposphere; mixed layer of the ocean, deep ocean; short-term land biosphere, long-term land biosphere, and marine biosphere. All exchanges are prescribed from literature or personal estimates except the troposphere-mixed ocean layer, which is obtained from a trial-and-error procedure using bomb $^{14}CO_2$ as a tracer. The CO_2 content predicted for the year 2000 is about 385 ppM compared with the present 320 ppM, if we assume the estimates of the growth in the use of fossil fuel are reasonable. Estimates of the global distribution of carbon monoxide, ozone, and methane were derived by trial-and-error modeling from data on steady-state concentrations, atmospheric motions, sources, and sinks. Some of the reasons for the uncertainties in the method are discussed. Data on hourly deposition rates of local fallout from underground cratering nuclear explosions were analyzed to provide modeling data on the amount and distribution of radioactivity in the initial cloud for this type of event. Computerized trajectory programs developed to calculate the trajectories of particles released at the Nevada Test Site are discussed. The post facto trajectory programs consider trajectories at constant isobaric pressure levels, in boundary layers, and at constant heights and each type of trajectory can be computed forward or backward in time for any desired duration. Forecast trajectory programs are used to forecast isobaric trajectories twice daily based on wind information obtained at standard pressure surfaces. (CH)

18337 HISTORY OF THE DEVELOPMENT OF PHYSICAL METHODS FOR INVESTIGATING THE RADIOACTIVITY IN THE ATMOSPHERE. Rogalya, A. M. Vop. Istor. Estestvozn. Tekh.; 1: No. 34, 31-41(1971). (In Russian).

The subject is reviewed with 144 references. (TTT)

18338 REMOVAL OF SHORT-LIVED RADON DECAY PRODUCTS FROM THE ATMOSPHERE BY HOARFROST. Avramenko, A. S.; Makhon'ko, K. P. Tr., Inst. Eksp. Meteorol.; No. 1, 51-67 (1972). (In Russian).

Results are presented of studies, made in 1970 and 1971 on the Kola Peninsula, of the principles of removal from air of natural radioactivity by hoarfrost. The hoarfrost was collected on metal rods, melted, and evaporated. Samples of atmospheric aerosols were collected by filtration. The radioactivity of the samples was determined by alpha radiography. Formulas are given relating the specific radioactivity of the samples to the number of alpha tracks in the emulsion. A "freezing-out" coefficient, K_m, was introduced to characterize the hoarfrost air-decontaminating properties. This coefficient indicates the volume of air from which radioactive impurities are completely removed, in unit time, in the transfer of 1 g of moisture from the air to the frost. This coefficient is related to the washout coefficient, δ, the entrapment, E, and the concentration of impurities, C/q. For a 20-mm-dia rod, average values were $K_m \approx 30$ cm^2/sec, $\sigma \approx 4 \times 10^{-5}$ sec^{-1}, $E = 10^{-2}$, and $C/q \approx 10^5$ cm^3/g. The dependence of K_m and σ on the hoarfrost formation time, T, formation rate, I, and quantity, m, was maximum at $T \approx 1$, $I \approx 20$ g/m.hr, and $m \approx 20$ g/m. The dependence of E on the humidity, ω, was minimum at $\omega \approx 1$ g/m^3 and K_m at $\omega \approx 2$ g/m^3. The value of σ increased monotonically with increasing ω. The dependence of E on the wind velocity was close to inversely proportional to the square root of the velocity, which is observed with convective diffusion of impurities to an obstacle. (tr-auth)

18339 DATA. Section III. Radioactivity in Air and Deposition. Radiat. Data Rep.; 14: No. 11, 696-705(Nov 1973).

Data are presented on the gross β activity due to fallout radionuclides in samples of surface air and precipitation collected during 1973 at various locations throughout the USA, Canada, Central America, and South America. (CH)

18340 RADON-222 FROM THE ISLAND OF HAWAII: DEEP SOILS ARE MORE IMPORTANT THAN LAVA FIELDS OR VOLCANOES. Wilkening, M. H. (New Mexico Inst. of Mining and Tech., Scorro). Science; 183: No. 4123, 413-415(1 Feb 1974).

The mean flux of ^{222}Rn atoms from the island of Hawaii is 0.45 atom per square centimeter per second. Lava fields occupy 50% of the land area, but their radon flux is only 1% of that from deep volcanic soils. The island yields approximately 10 Ci of ^{222}Rn per hour to the air surrounding it. The ^{222}Rn contribution of volcanoes is negligible. (auth)

18341 LONG DISTANCE DISPERSAL OF RADIOACTIVE FALLOUT AND NATURAL POLLEN. Estlander, A.; Kulmala, A. pp 61-70 of Scandinavian Aerobiology. Nilsson, S. (ed.). Stockholm; NRF, Editorial Services (1973).

Studies of radioactive fallout in Finland are described. Measurements of fallout from the surface explosions at Novaya Zemlya in 1965 and the underground explosions at Semipolarfinsk in 1967 are reviewed. The influence of weather, especially the direction of the winds on the amount of allout in Finland, is discussed. The last part of the document describes transport of biological particles and living creatures. (SW)

18342 RADIATION DOSES DUE TO ACCIDENTAL RELEASE OF RADIOACTIVE MATERIALS. Vogt, K. J. (Kernforschungsanlage, Juelich, Ger.). (1972). vp. (In German). (GSF-S-189).

From colloquium on meteorological problems occurring in reactor incidents; Nuremburg, Germany (May 1972).

A test was made to relate the emission strengths of the activities released into the atmosphere from nuclear facilities by means of propagation calculations to the resulting radiation burden via various exposure paths in the environment of the emittant. From there a generally applicable concept was developed for the calculation of the permissible activity discharges to the environment of nuclear facilities regarded as admissible dose limits (for normally operation emissions) or accidental standard values (for accidental releases). Quantitative criteria are established for the site selection and for the necessary and sufficient requirements for the safe design of nuclear facilities. By evaluation of the propagation equations for the exposure paths and suitable parameter representations of the results as a catalogue of sets of curves, nomograms, and isopleth representations, some material is provided which is available for planning purposes and which can be used for analysis and forecasts of environmental hazards. (GE)

18343 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 12, 752-761(Dec 1973).

Aug. 1973 measurements of the gross β-activity in surface air and precipitation at 78 sampling stations in the US and 24 stations in Canada, and in surface air only at 12 South American stations are presented. The gross β-activity in surface air measured at 6 stations during Jan. to July 1973 is reported. (LCL)

18344 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 1, 20-29(Jan 1974).

September 1973 data from measurements of the gross β-activity in surface air and precipitation at 15 US and 24 Canadian sampling stations and in surface air only at 98 US, 12 South American, and 14 California sampling stations are reported. (LCL)

18345 HISTORY OF THE DEVELOPMENT OF PHYSICAL METHODS FOR THE INVESTIGATION OF THE RADIOACTIVITY IN THE ATMOSPHERE (REVIEW). Rogalya, A. M. Vop. Istor. Estestvozn. Tekh.; No. 1, 31-41(1971). (In Russian).

18346 FUTURE GLOBAL ENVIRONMENTAL POLLUTION DUE TO TRITIUM AND KRYPTON-85 PRODUCED IN NUCLEAR REACTORS. Bonka, H. (Technische Hochschule, Aachen). ISU Mitt.; 2: No. 1, 99-108(1972). (In German).

In order to be able to assess whether the present and future release of tritium and ^{85}Kr to the environment will lead to an increase in the tritium and ^{85}Kr concentration in air and water during the next century that will exceed the maximum permissible values, a study has been made on the global environmental

pollution up to the year 2050, proceeding from currently available data and prognoses concerning the type and number of future nuclear power plants as well as reprocessing plants. The results indicate that the additional mean radiation doses due to the presence of tritium in water and in the atmosphere in the year 2050 will be lower than 0.02 mrem/a. Hence they will be lower by a factor of 10^4 than the permissible radiation dose to the population. The average radiation dose to the population in the FRG is 120 mrem/a. The release of ^{85}Kr, however, will cause a considerable increase of the radiation dose unless improved and efficient separation methods for ^{85}Kr are developed. The average radiation dose due to ^{85}Kr in the year 2050 has been estimated to be lower by a factor of 70 than the maximum permissible dose. (GE)

Soil

Refer also to abstracts 18380 and 19019.

18347 (BNWL-SA-4810) GENERAL STATISTICAL CONSIDERATIONS. Eberhardt, L. L.; Gilbert, R. O. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 11p. (CONF-731048-1). Dep. NTIS $3.00.

From NAEG plutonium environmental studies program meeting; Las Vegas, Nevada, USA (2 Oct 1973).

The high sampling variability encountered in environmental plutonium studies along with high analytical costs makes it very important that efficient soil sampling plans be used. However, efficient sampling depends on explicit and simple statements of the objectives of the study. When there are multiple objectives it may be difficult to devise a wholly suitable sampling scheme. Sampling for long-term changes in plutonium concentration in soils may also be complex and expensive. Further attention to problems associated with compositing samples is recommended, as is the consistent use of random sampling as a basic technique. (auth)

18348 (HW-60115) EXPLORATORY FIELD STUDY OF A GROUND WASTE DISPOSAL FACILITY. Haney, W. A.; Linderoth, C. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 May 1959. Contract W-31-109-eng-52. 22p. Dep. NTIS $3.25.

Declassified 23 Nov 1973.

In 1956 an extensive well drilling and soil sampling program was carried out in the vicinity of the Redox 216-S-1 and 2 cribs to study the distribution of radioisotopes in the soils beneath the cribs. Information is included on the crib history, monitoring well drilling and locations, radiological protection procedures used during well drilling, and the collection analysis, and interpretation of contaminated sediment samples. The results showed that: the waste spread from an initial area of 4000 ft^2 to the ground water, 80,000 ft^2; geological data can be used to predict directions of waste movement and extent of spreading; ^{90}Sr reaching ground water encompassed an area of about 10,000 ft^2; ^{137}Cs is confined to the upper strata immediately under the crib site; and about 0.01 Ci of ^{90}Sr is contained in the 10 ft of soil above the ground water table. It is concluded that this well drilling and soil sampling method can be expected to provide fairly accurate information relative to radioisotope distribution and waste dispersion. (LCL)

18349 (HW-61787-RD) 216-Z-9 CORE SAMPLING DATA. Reisenauer, A. E. (Hanford Works, Richland, Wash. (USA)). 3 Sep 1959. Contract W-31-109-eng-52. 6p. Dep. NTIS $3.00.

Four one-inch diameter core samples taken from the soil beneath the Hanford 216-Z-9 Recuplex waste storage crib at Hanford during 1959 were examined for Pu content to collect data to permit evaluation of the life of the crib. Concentrations as high as 1.5 mg Pu/cm^3 of soil were found in one of the cores. Results of the analyses indicated that approximately 8 kg of the 13 kg of Pu disposed to this crib might be located within the upper few cm of soil beneath the crib. (CH)

18350 (HW-79805) GEOLOGY UNDERLYING THE 241-AX TANK FARM. Brown, D. J. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 20 Dec 1963. Contract AT(45-1)-1350. 8p. Dep. NTIS $3.00.

Evaluation of the sediment types and the stratigraphy beneath the new 241-AX tank farm was made on the bases of drill-log data, sieve analyses, and visual examination of well drilling samples. Although the materials underlying the tank farm were generally coarse and were more uniform than those common to other 200 Area locations, six distinguishable facies changes were noted. Such changes would retard channeling and promote the horizontal spreading of liquid waste moving through the vadose zone at this site. (auth)

18351 (HW-81676) SOLUTION OF VERY LARGE GROUND WATER FLOW PROBLEMS. Digital Methods Versus Analog Simulation. Nelson, R. W. (Hanford Works, Richland, Wash. (USA)). 2 Feb 1964. Contract AT(45-1)-1350. 9p. Dep. NTIS $3.00.

In order to analyze contamination transport through soils, very large boundary value problems describing ground water flow must be solved either by a digital computer solution or analog simulation. These two methods are compared on the basis of directness of solution, flexibility, and cost. It is concluded that the digital method has lower expected research and development costs plus the advantageous capability of being able to handle partially saturated flow and is preferable to analog simulation. (LCL)

18352 VERTICAL DISTRIBUTION OF FALLOUT CESIUM-137 IN CULTIVATED SOILS. Ritchie, J. C.; McHenry, J. R. Radiat. Data Rep.; 14: No. 12, 727-728(Dec 1973).

Fallout ^{137}Cs was found to be evenly distributed in the upper 15 to 20 cm of cultivated soils of five watersheds in the mid-United States. This distribution pattern is markedly different from the vertical distribution of ^{137}Cs in noncultivated soils. (auth)

18353 STRONTIUM ISOTOPE COMPOSITION AND SEDIMENT TRANSPORT IN THE RIO DE LA PLATA ESTUARY. Biscaye, P. (Geological Observatory, Palisades, NY). Geol. Soc. Amer., Mem.; No. 133, 349-357(1972). (COO-3132-11).

Analyses of rubidium, strontium, and strontium isotope composition were made on a set of whole, surface-sediment, carbonate-free samples from the Plata estuary, its major source rivers, and the adjacent continental shelf. Rubidium and strontium analyses were also made on the greater-than-20-micron and less-than-20-micron fractions of the samples to determine the effect of size frequency distribution on one of the parameters. Because the Rb to Sr ratio, and presumably the ^{87}Sr to ^{86}Sr ratio, varies with grain size, some of the large variability in ^{87}Sr to ^{86}Sr in the Plata must be due to differential sedimentation processes within the estuary. Consideration of the data on an isochron diagram reduces some of this ambiguity and is consistent with an interpretation of two major sources of sediment in the estuary. These sources are the rivers Parana and Uruguay at the head of the estuary and Argentine continental shelf sediment at the mouth. A third source, Uruguayan shield material reported by Urien (this volume) along the estuary's north shore, is not distinguishable in the data presented here. (auth)

Water

Refer also to abstracts 18072 and 18321.

18354 (AED-C-25-3) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 25. Maritime Radiology. Number 3. (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Nov 1973. 74p. (In several languages). Dep. NTIS (U. S. Sales Only) $5.75.

Some 200 references to publications from the world literature on the radioactivity in ocean sediments and waters are presented. Sampling and measuring methods are included. Keywords in English are provided for each item. Subject, author, and location indexes are included. (CH)

18355 (AED-C-25-4) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 25. Maritime Radiology. Number 4. (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Dec 1973. 94p. (In several languages). Dep. NTIS (U. S. Sales Only) $6.75.

Some 250 references to publications from the world literature on the radioactivity in ocean sediments and waters are presented. Sampling and measuring methods are included. Keywords in English are provided for each item. Subject, author, and location indexes are included. (CH)

18356 (BNWL-CC-2326) ANALYSIS OF TRAVEL TIME OF ^{131}I FROM THE 1301-N CRIB TO THE COLUMBIA RIVER DURING JULY 1969. Crews, W. S.; Tillson, D. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Dec 1969. Contract AT(45-1)-1830. 29p. Dep. NTIS $3.50.

The 1301-N crib at Hanford receives waste waters from the 100-N Reactor operation. The crib, which has been in service since 1964, receives an average flow of approximately 2000 to 2500 gal/min waste water. Radionuclide concentration of the influent stream to the 1301-N crib can fluctuate significantly in very short periods of time, but the quantitative spectra of the crib influent during normal operation will be heavily weighted with ^{3}H followed by ^{51}Cr and ^{131}I. When a fuel element failure occurs, the major contribution to the radionuclide inventory of the 1301-N crib influent will come from the reactor coolant bleed systems. For a short period, 1 to 8 hr following a fuel element

failure, the quantitative spectra of the crib influent will be dominated by ^{131}I. Correlations of concentration peaks at the crib influent with a subsequent appearance of corresponding peaks in downgradient groundwater monitoring wells and in the riverbank springs, which have developed since crib operation was begun in 1964, provide a means for determining radionuclide travel times in the ground system. Data are presented on ^{131}I concentrations in well and riverbank spring samples taken over a period of 30 days following two fuel element failures, 1 week apart, during the first part of July 1969. The minimum travel time from the 1301-N crib to the Columbia River was approximately 9 ± 1 days for ^{131}I during this period. The peak of maximum concentration of ^{131}I occurred approximately 15 ± 1 days after release to the ground system. (CH)

18357 (TID-26516) TRITIUM AND CESIUM IN PAR POND. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1966. 5p. Dep. NTIS $3.00.

Impoundment of water in Par Pond to provide an additional source of cooling water for the R and P reactors began August 21, 1958. Sufficient water for pumping was impounded by October 14, 1958. Spillway overflow to Lower Three Runs Creek began December 30, 1960. The capacity of the 2800-acre lake is 1.8×10^{10} gallons of water. The R Area contributed radioactive materials (principally in disassembly basin water) to Par Pond from 1958 until the disassembly basin flow was stopped October 8, 1964. During the 6-year period, these contributions totaled ~94,700 curies of tritium and 2400 curies of other nuclides. On the basis of specific analyses beginning in 1961, the short-lived isotopes ^{239}Np and ^{51}Cr constituted 80% of the other nuclides, and $^{134+137}Cs$ (154 curies), ^{89}Sr (25.8 curies), and ^{90}Sr (12.4 curies) constituted the major portion of the long-lived isotopes released. The P Area received some cooling water from Par Pond (containing the R-Area activities) beginning in 1958. Until May 1961, this water was discharged entirely to Steel Creek; thereafter until December 1963 some of the cooling water was returned to Par Pond, and since December 1963 all of the P-Area cooling water has been returned to the pond. Specific analyses of certain isotopes show the following releases to Steel Creek between 1960 and 1963 in cooling water from Par Pond: $^{134+137}Cs$ 19.8 Ci; $^{89,90}Sr$ 6.6 Ci; and ^{3}H 52,400 Ci. Beginning in September 1958, weekly samples of water were collected from the pond at the pump house. Monthly concentrations of nonvolatile beta, tritium, radiocesium, and radiostrontium from 1959 to date are presented. High concentrations of cesium and strontium during 1963 were attributed to storage in the R-Area basis of partially unclad experimental fuel elements in vented cans. The peak concentrations of cesium and tritium in 1964 were attributed to cleanup of the R-Area emergency disassembly basin and flushes of the reactor. (auth)

18358 (TID-26519) SORPTION OF Sr AND Cs BY STREAM BEDS. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1965. 4p. Dep. NTIS $3.00.

Data are presented on the ^{137}Cs, ^{89}Sr, and ^{90}Sr content in water at two locations along the Lower Three Runs Creek, which indirectly receives radioactive material discharged during the operation of the R reactor. These data show that the stream bed acted as an ion exchange system. (LCL)

18359 TRITIUM CONTENT OF UNDERGROUND WATER IN THE WAGGA AREA. Barnes, J.; Carswell, D. J. Geol. Soc. Aust.; 20: No. 2, 175-177(Jun 1973).

Measurement of the tritium content of water taken from bores along the Murrumbidgee River has yielded information concerning the permeability and flow characteristics of the underground aquifer in the Wagga area of New South Wales. The replenishment of the aquifer in time of high river levels has been established, the effect on the aquifer resulting from heavy pumping in the Wagga area has been studied, and some of the more unusual aquifer structures have been investigated. (auth)

18360 RADIOLOGICAL SURVEY OF NEW LONDON HARBOR, THAMES RIVER, CONN., AND ENVIRONS. Windham, S. T. (Eastern Environmental Radiation Facility, Montgomery, AL); Phillips, C. R. Radiat. Data Rep.; 14: No. 11, 659-666(Nov 1973).

In July 1972, the Eastern Environmental Radiation Facility, in cooperation with the U. S. Naval Ship Systems Command, conducted a radiological survey of the New London Harbor, Thames River and environs to determine if nuclear ship activity in that area has contributed radioactivity which could result in detectable radiation exposure to the public. Comparison with a similar survey conducted in 1966 shows that ^{60}Co activity levels in sediment have decreased by an average factor of 33 due to a reduction in the amount of radioactivity discharged, radioactive decay, and natural sedimentation. Analysis of samples indicative of direct pathways for human exposure leads to the conclusion that no significant radiation exposure to the public has resulted from nuclear ship operations in this area. It is concluded that the environmental surveillance routinely conducted by the Navy should be adequate to assure protection of the public from the routine nuclear ship operations. (auth)

18361 DATA. Section II. Radioisotope Content of Water. Radiat. Data Rep.; 14: No. 11, 684-695(Nov 1973).

Data are presented on the content of tritium and the gross α and β activity in samples of drinking water, surface waters, and sewage collected at various locations throughout the USA during 1972 and 1973. (CH)

18362 DISTRIBUTION AND UPTAKE OF ARTIFICIALLY INTRODUCED RADIUM-226 IN A SMALL LAKE. Emerson, S.; Hesslein, R. (Columbia Univ., Palisades, NY). J. Fish. Res. Board Can.; 30: No. 10, 1485-1490(Oct 1973).

Radium-226 was added to lake 227 of the Experimental Lakes Area in August 1970 so that gas-exchange rates between the atmosphere and the lake could be traced by its gaseous daughter product radon-222. Although we expected the radium to remain in solution it did so for only about 1 month. An investigation to locate the radium after it left solution revealed that it was taken up on the bottom in the littoral zone. Further experiments indicated that it had adsorbed to the algal detrital material on the littoral sediment surface. Seasonal movement of this material could thus be monitored by following the movement of the radium with time. (auth)

18363 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 1, 13-19(Jan 1974).

Data from radiation monitoring during Sept. 1973 of surface, ground, and drinking waters sampled in California, Nevada, and Utah are reported. Tabulated data are presented for the radioisotope contents of water samples collected in the same area during 1973. (LCL)

18364 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 12, 746-752(Dec 1973).

Data from the radiation monitoring during Aug. 1973 of surface, ground, and drinking waters sampled in California, Nevada, and Utah are reported. Data on the ^{90}Sr content during 1955 to 1973 and ^{137}Cs and ^{90}Sr contents during Jan. through Dec. 1972 in New York City tap water is also presented. (LCL)

18365 MEASUREMENT OF THE SPECIFIC RADIOACTIVITY OF THE WATER WITH BIG SALT CONTENTS. Grossman, A.; Kwapulinski, J. (Silesian Technical Univ., Gliwice, Poland). Przegl. Geofiz.; 17: 155-164(1972). (In Polish).

The conventional method of determining the global beta radioactivity is not suitable for waters with weak radioactivity, but with high contents of mineral salts (such as bottom waters in the mines), since they require very long times, sometimes many hours, of exposure. In such circumstances, it is suitable to use the so-called thick-layer method with simultaneous lowering of the proper course of measuring instruments by applying the anticoincidence system. In that manner the time of measurement can be abbreviated manifoldly and the accuracy can be amended considerably. Even the very application of the thick-layer method, by not requiring any special instrumentation, assures a very distinct improvement of the measured parameters. (auth)

18366 PROPOSITION FOR THE INTERNATIONAL CONTROL OF RADIOACTIVE CONTAMINATION OF THE DANUBE, IN ACCORDANCE WITH THE ATOMIC ENERGY DEVELOPMENT PROGRAMES OF DANUBE COUNTRIES. Kelemen, L.; Barfai, S.; Meszner, J. (Orszagos Vizugyi Hivatal, Budapest). Izotoptechnika; 16: No. 12, 654-662(Dec 1973). (In Hungarian).

In view of future water demands and construction programs of nuclear power stations a proposition is promoted to develop a standard international system for the control of radioactive contamination of the Danube and to organize a regional center for data handling and storing. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 18604 and 18657.

18367 (COO-1156-63) RADIOECOLOGY OF SOME NATURAL ORGANISMS AND SYSTEMS IN COLORADO. Eleventh Technical Progress Report, May 1, 1972–April 30, 1973. Whicker, F. W. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 1 May 1973. Contract AT(11-1)-1156. 95p. Dep. NTIS $6.75.

The broad purpose of this research is to provide information on the behavior of radionuclides in, and radiation sensitivity of, selected organisms and natural ecosystems in Colorado. Components of alpine tundra, montane forests, shortgrass plains, and freshwa-

ter lakes and streams are currently under investigation with respect to behavior and effects of radionuclides. Data are presented from studies on the content of ^{238}Pu and ^{239}Pu in samples of soil, litter, vegetation, and tissues of mule deer, rodents, and birds collected in the vicinity of Rocky Flats; the content of fallout ^{137}Cs and ^{90}Sr in the tissues of mule deer and in forage samples; the migration of ^{137}Cs through food chains in a lake ecosystem; tracer studies of energy flow from the dominant grass of the shortgrass plains, Bouteloua gracilis, through arthropod consumers, using ^{32}P as the tracer and grasshoppers as the test organism; and the effects of γ radiation from a large ^{137}Cs source on arthropods, microorganisms, and soil chemistry of a chronic irradiation field. (CH)

18368 DATA. Section I. Radioisotope Content of Milk and Food. Radiat. Data Rep.; 14: No. 11, 667-683(Nov 1973).

Data are presented on the content of fallout ^{89}Sr, ^{90}Sr, ^{131}I, ^{137}Cs, and ^{140}Ba in milk samples collected throughout the USA and at selected locations in Canada, Central America, and South America during July 1973. Data are also included on the content of ^{14}C in milk and samples of the total diet during 1972 and 1973 and the content of ^{137}Cs and ^{90}Sr in samples of the total diet collected during January through March 1973. (CH)

18369 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 12, 731-745(Dec 1973).

Data on the ^{137}Cs and ^{90}Sr content in milk at 63 sampling stations in the US, 16 in Canada, and 7 stations in Central and South America are reported for August 1973 and for the 12-month period from September 1972 to September 1973. (LCL)

18370 IODINE-131 IN MILK SAMPLES, JULY 9, 1973 THROUGH AUGUST 23, 1973. Geiger, E. (Eberline Instrument Corp., Santa Fe, NM); Trautman, M. A. Radiat. Data Rep.; 14: No. 12, 729(Dec 1973).

Tabulated data are presented on the ^{131}I content in milk samples from three midwestern areas of the US. (LCL)

18371 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 1, 1-12(Jan 1974).

Data on the ^{137}Cs and ^{90}Sr content in milk at 63 sampling stations in the US, 16 in Canada, and 7 in Central and South America are reported for Sept. 1973 and for the 12-month period from Oct. 1972 to Oct. 1973. Data for Sept. 1973 on the ^{137}Cs, ^{89}Sr, ^{90}Sr, and tritium content in milk sampled at 24 stations in California, Nevada and Utah are tabulated. (LCL)

Radiometric Techniques

Refer also to abstracts 18353–18355, 18362, and 18380.

18372 YADERNO-GEOFIZICHESKIE METODY OPROBOVANIYA PRI DOBYCHE I PERERABOTKE MINERAL'NOGO SYR'YA. (Nuclear-Geophysical Methods of Sampling in the Extraction and Processing of Mineral Raw Materials). Nifontov, B. I.; Avsaragov, Kh. B. Leningrad; Izdatel'stvo Nauka (1972). 150p. (In Russian).

Problems connected with the feasibility of geophysical methods of sampling in mines are examined. The advantages of geophysical methods in comparison with geological methods are evaluated. An analysis is given of the present status of geophysical sampling. New results on copper-nickel, apatite, and rare earth ores are described. The high economic efficiency of the use of geophysical sampling in these deposits is discussed. Laboratory results of studies on the development of methods of nuclear-geophysical sampling were reported. (tr-auth)

18373 EFFECT OF RESONANCE SCATTERING ON THE DISTRIBUTION OF NEUTRONS IN ROCKS. Kozhevnikov, D. A. At. Energ. (USSR); 35: No. 1, 62-63(Jul 1973). (In Russian).

Experimental results indicated that the effect of the resonance structure of the scattering cross section of neutrons on atoms of rock-forming elements has no practical value in the quantitative interpretation of the results of borehole measurements. (JSR)

18374 DATA PROCESSING IN ^{14}C-MEASUREMENT. II. Age Calculation. Erlenkeuser, H.; Willkomm, H. (Univ., Kiel). Atomkernenergie; 22: No. 2, 90-94(Oct 1973).

A computer program for radiocarbon age calculation was written for a routine dating laboratory with automatic data recording. The schedule of the data processing and the different modes of evaluation by control commands are outlined. The influence of the counter filling pressure and of the cosmic ray muon intensity on the background, and the confidence limits of the ^{14}C age are discussed. The radiocarbon dates are dendrochronologically corrected by the program. (GE)

18375 NaOH ETCH OF FISSION TRACKS IN A SODA-LIME-SILICA GLASS. Davison, C. C. (Univ. of California, Berkeley). Nature (London); 247: No. 5436, 103(11 Jan 1974).

The use of NaOH for etching fission tracks in a soda-lime-silica glass is reported; the material in question consisted of glass beads found in archaeological sites in Africa. These beads are thought to contain fossil fission tracks useful for dating purposes. In an attempt to find a suitable etch for such tracks experiments were carried out on artificially produced fission tracks in the beads. HF at various concentrations at room temperature did not etch the tracks preferentially, but successful etching occurred on refluxing for 7 min in NaOH. The reflux solution was prepared by dissolving 12 g NaOH in 16 g water. (UK)

18376 NUCLEAR GEOPHYSICAL METHODS FOR WELL SURVEYING OF KIRGIZIYA MERCURY DEPOSITS. Erkhov, V. A.; Makarov, Yu. I.; Yaroslavtsev, V. F.; Edorov, E. V.; Sokolov, E. V.; Ochkur, A. P. Razved. Okhr. Nedr; No. 2, 30-34(1973). (In Russian).

Results are given of the assaying and introduction in the Kirgiziya mercury deposits of nuclear geophysical methods: neutron-neutron logging with thermal neutrons, selective γ logging, spectrometric neutron-γ logging, and x-ray radiometric logging. The most effective complex was determined and included x-ray radiometric logging and spectrometric neutron-γ logging. (tr-auth)

18377 FALLOUT ^{90}Sr AS A TRACER FOR GROUNDWATER STUDIES. Aurand, K. (Bundesgesundheitsamt, Berlin); Wolter, R.; Matthess, G. Geol. Jahrb.; 303-313(1973). (In German).

Fallout ^{90}Sr is present in groundwater in concentrations of some fCi/l. A method is described suited to detect 0.3 fCi/l ^{90}Sr. Measurements at wells and springs performed continuously or discontinuously since 1963 are interpreted with regard to groundwater movements and balance. Results of measurements can be used to complete studies of groundwater movement in fissured rocks, karstified rock, and unconsolidated aquifers. (auth)

Site Surveys

Refer also to abstracts 18349, 18350, 18356, and 18393.

18378 (AE-483) ZOOPLANKTON IN TVAREN 1961–1963. Almquist, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 50p. Dep. NTIS (U. S. Sales Only) $4.50.

An investigation of the zooplankton in Tvären, a bay of the Baltic, was carried out during the period January 1961 to July 1963. The aim of the investigation was to give information about the qualitative and quantitative composition of the zooplankton before the release of waste water from the research station of AB Atomenergi at Studsvik began. The highest volumes of zooplankton were obtained in the late spring and late autumn. The ciliates were represented by large numbers of individuals and species; the copepods, however, due to their greater biomass, were normally the dominating group. The metaplanktic larvae account for an important part of the zooplankton biomass, especially in spring and summer. (auth)

18379 (BNWL-1796) VASCULAR PLANTS OF WASTE STORAGE SITES IN THE 200 AREAS OF THE HANFORD RESERVATION. Price, K. R.; Rickard, W. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1973. Contract AT(45-1)-1830. 8p. Dep. NTIS $4.00.

A brief accounting of terrestrial, riparian and semi-aquatic plants known to be associated with radioactive waste storage sites in the 200 Areas of the Hanford Reservation is given. In most cases the species are characteristic of those which generally inhabit the reservation, but some plants are restricted to specialized habitats provided by particular waste storage sites. It is impractical to list all species growing at each waste storage site because of seasonal variation and changes brought about by environmental management practices. An alphabetical listing has been prepared with an example of where each species is known to occur. The list will be updated as needed and expanded to include other waste storage areas. Plant specimens were collected during spring and fall when flowering material was available. Herbarium mounts were prepared of many specimens and have been retained as part of the Hanford Reservation herbarium collection. Identification to species level was made whenever possible. Color photographs of the specimen mounts are used as training aids and demonstration material by ARHCO Radiation Monitoring personnel. (auth)

18380 (BNWL-SA-4815) STATISTICAL ANALYSIS OF Pu IN SOIL AT NTS: SOME RESULTS (AN OUTLINE). Gilbert,

R. O.; Eberhardt, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. 22p. (CONF-731048-2). Dep. NTIS $3.25.

From NAEG plutonium environmental studies program meeting; Las Vegas, Nevada, USA (2 Oct 1973).

The inventory of ^{239}Pu and ^{240}Pu at various depths in surface soil samples collected from various locations at the Nevada Test Site was determined. Isopleths were constructed for use in stratified random sampling to estimate surface inventory. Gamma scans for ^{241}Am were made on all soil samples for comparison with the determinations of ^{239}Pu and ^{240}Pu made using wet chemistry techniques. (CH)

18381 (HW-15882) STUDY OF THE EFFECTS OF A DISASTER AT GRAND COULEE DAM UPON THE HANFORD WORKS. Kramer, H. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 3 Feb 1950. 18p. Dep. NTIS $3.00.

Declassified 23 Nov 1973.

It is assumed that the Grand Coulee Dam would be destroyed by one direct hit following detonation of an atomic bomb. Major effects of the explosion include flooding and isolation of Richland, flooding of Midway Substation, and flooding of surrounding areas. Maximum water elevations following a direct hit and indirect hits are estimated. Data are presented for flow through openings and flow through dam failure. (HLW)

18382 (HW-80558) GROUND WATER TRAVEL TIME CALCULATIONS FOR THE 1301-N CRIB. Brown, D. J. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 30 Jul 1964. Contract AT(45-1)-1350. 14p. Dep. NTIS $3.00.

The 1301-N crib, located in the northern part of 100-N area of Hanford and approximately 800 feet from the Columbia River, was constructed to receive liquid radioactive waste from the primary coolant loop of the N-reactor. It was expected that this waste stream would contain activation products and also fission products from failed fuel elements. The hydraulics of the crib flow system were evaluated by analyzing the existing flow system at a location where the underlying sediments have similar hydraulic characteristics, where wastes have been discharged into the ground over a long period of time, and where springs have developed to maturity along the riverbank. It was concluded that, although the calculated minimum travel time for waste to move from the crib to the river is about 12 days, the actual minimum travel time would probably be close to 96 days. It was also concluded that there would be no appreciable change in the travel time due to the eventual development of springs along the riverbank. (CH)

18383 (NP-19905) BIBLIOGRAPHY OF THE ZOOLOGY OF TENNESSEE AND THE TENNESSEE VALLEY REGION. Shoup, C. S. 1974. 251p. Dep. NTIS $7.60.

A list is presented of 3,352 published papers from the periodical literature, reports, and dissertations dealing with the fauna of Tennessee and nearby areas in the valleys of the Tennessee and Cumberland Rivers. A locality index is included. (CH)

18384 STUDIES EFFECTED ON THE SITING OF NUCLEAR INSTALLATIONS. Coulon, R. (CEN, Fontenay-aux-Roses, France). Agriculture (Paris); No. 366, 184-186(Jun 1973). (In French).

The siting of nuclear electricity power plants, irradiated fuel reprocessing plants, or nuclear research centers necessitates prior investigations of the possible consequences on the environment and man. Studies were carried out on the effect of radionuclide transfer into the environment. The legal problems involved in the choice of reactor site are considered. Once a site has been decided on, pre-operational studies are carried out in order to establish the relations existing between the installation envisaged and the environment. These studies concern the natural environment, agriculture, and economic and human factors. A monitoring program ensures that the amount of waste does not exceed certain predicted levels. (FR)

18385 PRESENT STATUS OF METEOROLOGICAL SITE INVESTIGATIONS FOR NUCLEAR POWER PLANTS. Jurksch, G. (1972). vp. (In German). (GSF-S-189).

From colloquium on meteorological problems occurring in reactor incidents; Nuremburg, Germany (May 1972)..

The German Meteorological Service does not have any influence on the site selection of a nuclear power plant. It is concerned with meteorological site studies instigated by the proper licensing authorities and then occupies the position of an independent expert. The site judgment to be made runs parallel to the construction of the plant; the results come into the propagation calculations, they are used in the operating license. The meteorological judgment of a nuclear power plant is principally affirmed. It offers, by special measurements at the reactor site, assured data on local climatic characteristics and on local propagation situations. It should be broadly applied and performed by timely planning without time pressure. Its size and duration depend on areal relief of the reactor site. A full meteorological judgment can be completed within 1½ to 3 years. (GE)

18386 PROGRAM FOR STUDYING DISPERSION PROCESSES WITH SPECIAL METEOROLOGICAL CONDITIONS. Nester, K. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German). (GSF-S-189).

From colloquium on meteorological problems occurring in reactor incidents; Nuremburg, Germany (May 1972).

Theoretical and experimental detection of dispersion processes due to simple meteorological parameters and under special meteorological conditions, experiences, the composition of statistics, the steadiness and frequency of meteorology conditions at the sites concerning reactor incidents and the meteorological distribution of concentrations are discussed. (GE)

18387 AUTOMATIC DATA ACQUISITION WITH A METEOROLOGICAL MEASURING MAST. Huebschmann, W. G. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). vp. (In German). (GSF-S-189).

From colloquium on meteorological problems occurring in reactor incidents; Nuremburg, Germany (May 1972).

The purpose of the 200 m high measuring mast at the Karlsruhe Nuclear Research Center, the installation of instruments on the tower for measuring profiles of wind speed, wind direction, temperature, and humidity, and the data acquisition and cost are described. (GE)

Thermal Effluents

Refer also to abstract 20069.

18388 (COO-3062-18) DISTRIBUTION OF EXCESS TEMPERATURE FROM THE MONGANTOWN GENERATING STATION ON THE POTOMAC ESTUARY. Carter, H. H. (Johns Hopkins Univ., Baltimore, Md. (USA). Chesapeake Bay Inst.). Oct 1973. Contract AT(11-1)-3062. 105p. Dep. NTIS $7.25.

Research undertaken to determine the effects of thermal effluents on the temperature distribution in estuarine waters is described. Procedures for and results from measurements of the temperature, river flow, tidal currents, salinity, wind, etc at the Potomac River estuary in 1969 and 1972, which represent pre- and post-operation conditions for the operation of the fossil-fueled Morgantown power plant, are reported. (LCL)

18389 (EPA-660-2-73-4) NOMOGRAPHS FOR THERMAL POLLUTION CONTROL SYSTEMS. Jedlicka, C. L. (Environmental Protection Agency, Washington, D. C. (USA). Office of Research and Development). Sep 1973. 171p. GPO $1.80.

Nomographs are presented and described which permit the estimation of heat rejection system performance, tower or pond capital costs, and the perturbations to power plant efficiency and costs which result from the incorporation and operation of any one of the following thermal pollution control systems within a power plant as a substitute for once-through cooling: natural draft wet towers; mechanical draft wet towers; spray ponds; cooling ponds; and natural and mechanical draft dry towers. The base case plant for cost comparisons is chosen as having a nominal turbine back pressure of 2 in. Hg absolute. The total heat rejection system with its associated costs is defined to extend outward from the turbine exhaust flange, a common boundary for each of the systems mentioned above. Performance and capital costs for the thermal pollution control systems were compared with data from existing facilities and theoretical estimates from various sources. (auth)

18390 (HW-77170) STATUS OF THE GROUND WATER BENEATH HANFORD REACTOR AREAS, JANUARY 1962–JANUARY 1963. Brown, D. J. (Hanford Works, Richland, Wash. (USA)). Apr 1963. 14p. Dep. NTIS $3.00.

Several years after operations started in each of the Hanford reactor areas, the temperature of the ground water beneath those sites increased noticeably. It was found that the temperature increase in most cases was caused by thermally hot reactor effluent cooling water percolating downward into the ground through cracks and joints in the bottom of the 107 retention basin structures and leaking pipe lines carrying the water to these basins. As a result of this leakage, groundwater mounds were formed beneath the retention basins which greatly increased the hydraulic gradients between the basins and the Columbia River. The gradients thus formed were sufficient to produce river-bank thermal springs in

the proximity of the retention basins at each reactor area. In 1962, a study was made to determine the effects that thermally hot ground water might have on reactor operations. A temperature probe was developed and used to obtain temperature-profile data on the ground water beneath each of the reactor sites. These data were used to calculate temperature distributions in the ground water. Knowledge of the temperature distributions and the geologic and hydrologic characteristics at each site permitted the determination of the heat flow via the ground water into the Columbia River. Isotopic analyses of well and spring waters were used to confirm the present hydrologic concepts regarding the direction and rate of ground-water movement beneath the areas. An interpretation of the temperature data obtained from this study, together with perspective sketches of the water table beneath each of the reactor areas, is presented. Although some previous evidence pointed to the possibility of a natural source of thermally hot ground water beneath the 100-B Area, this was contraindicated by the temperature logging data. Temperature profiles indicate the only sources of thermally hot water in the region of the reactor areas are reactor effluent cooling water leakage and local discharge. (auth)

18391 ENVIRONMENTAL PROTECTION BY DRY-TYPE COOLING FOR POWER PLANTS. Heeren, H. (Maschinenfabrik Augsburg-Nuernberg AG, Nuremberg). Umsch. Wiss. Tech.; 73: No. 21, 672-673(Nov 1973). (In German).

Dry cooling using air-cooled elements offers a feasible solution for protecting the ecosystem which has proved its value in practice. There are two alternative methods of dry cooling, direct and indirect. The latter concept is being promoted where the steam exhausted by the turbine condenses in a spray condenser. This is connected to a closed water circuit from which the heat is removed by means of water-to-air heat exchangers. An improved version of this system is discussed where a refrigerant is used in the primary circuit. This system lends itself especially to nuclear power applications. (GE)

18392 THERMAL LOAD OF AN IMPOUNDED LAKE CAUSED BY THE COOLING WATER DISCHARGE FROM A NUCLEAR POWER PLANT. Schorr, H. Waerme; 79: No. 5, 69-80(Oct 1973). (In German).

The thermal load of an impounded lake arising from the operation of a 1,000-MW nuclear power plant is studied. The study was made for the river Lech and the lake Forggensee as all relevant data of that system was available. Therefore, the values given in this study refer to this lake, but the procedure described can be applied to the evaluation of the thermal conditions of any other impounded lake. (GE)

Chemical Effluents

Refer also to abstracts 18056, 18336, 20533, and 20534.

18393 (CEA-R-4501) MEASUREMENT OF THE DYNAMIC CHARACTERISTICS OF ATMOSPHERIC DIFFUSION. Rigot-Muller, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jan 1974. 68p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

A method is proposed for studying the diffusion of atmospheric pollutants above real sites, which considers the actual magnitudes encountered. The dynamic application of this method yields original information. In view of justifying the method, fundamental theories concerning diffusion are presented together with different models for the atmosphere. The atmosphere is then considered as a linear filter to which the process identification method is applied. The pulse response of the filter is examined in the pollutant-time plane. The limits of the method and its field of application are discussed. The concepts of ergodism and stationaryness are introduced. Various diffusion experiments carried out under different conditions are reviewed. Information on the effect of obstacles and the roughness of the ground is given together with calculations on the longitudinal diffusion and the transport velocity. A brief description is then given of the apparatus used to measure the concentrations and the meteorological conditions. The correlation calculation is also briefly presented. (auth)

18394 REMOVAL OF SULFUR OXIDES FROM FLUE GASES BY POWDERED LIMESTONE. Zalogin, N. G. (All-Union Heat Engineering Inst., Moscow). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 1, 46-50(Jan 1973).

Translated from Teploenergetika; 20: No. 1, 33-37(1973).

It was concluded that the method described for removing sulfur dioxide from flue gases of high-sulfur-content fuels is the simplest method since it does not require any additional equipment for preparing the absorbent, for implementing the absorption process and for removing wastes formed at the power stations. The cheapest alkali compound, limestone, is used as an absorbent. The technology of purifying gases by this method appreciably affects the processes taking place in steam generators, in the ash removal system, and in removing the wastes, and complicates the operation of equipment at the station. The main shortcoming of purifying gas by this method is the low intensity of the reaction between gaseous sulfur dioxide and powdered calcium oxide, which requires considerable excess of limestone; however, it does not enable one to attain thorough purification of gases. Work on reducing the cost of gas purification by this method should be directed at increasing the degree of fineness of the calcium oxide, at partial recirculation of unused calcium oxide, and at increasing the time of contact of gases with calcium oxide at a temperature at which the intensity of their reaction is a maximum, and at finding methods of the most efficient use of the wastes. (auth)

18395 DETERMINING THE AIR PREHEATING TEMPERATURE WHEN BURNING OIL OF HIGH SULFUR CONTENT. Tsirul'nikov, L. M.; Mesrop'yan, R. A. (Tashkent Polytechnic Inst.). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 1, 100-102(Jan 1973).

Translated from Teploenergetika; 20: No. 1, 72-73(1973).

18396 INVESTIGATION OF THE FORMATION OF SULFUR DIOXIDE WITH COMBUSTION OF LIQUID HIGH-SULFUR-CONTENT IN A CYCLONE CHAMBER. Glebov, V. P. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 1, 51-54(Jan 1973).

Translated from Teploenergetika; 20: No. 1, 37-39(1973).

18397 FLUORINE: A POLLUTANT AGENT OF THE ATMOSPHERE. Vasiliu, L.; Buiculescu, I. Natura (Plovdiv); 24: No. 6, 66-71(1972).

After a discussion of the fluorine in the industrial regions of Romania and the concentration limits over which it becomes noxious, data are presented about morpho-physiological changes in vegetable organisms under the noxious action of the fluorine, i.e. changes in leaves, flowers, and fruit. The noxious effects of this pollutant on the morphology and physiology of animal organisms as well as on the structure and composition of the populations are analyzed. Plants are more directly and strongly influenced by intense pollution of air than the animals which can leave the affected zones. The abundance and frequency of the animals decrease in the polluted zones even to the point of total disappearance of some species, which fact brings about disturbances in the biotic equilibrium of the natural communities. The organisms which are more connected with the biotic factors and which cannot be removed can be characteristic elements in studying the effects of the pollution. (Rom. Sci. Abstr.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 20289 and 20301.

18398 (IPP-IV-60) BASIC EQUATIONS AND FUNDAMENTAL DATA FOR COMBUSTION MHD GENERATORS. Raeder, J.; Buende, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 225p. (In German). Dep. NTIS (U. S. Sales Only) $13.25.

The basic equations of magnetogasdynamics are summarized. From these general equations a set of stationary one-dimensional flow equations and a simplified Ohm's law are derived for special application to MHD channel flow. The method of calculating the plasma composition, thermodynamic functions and transport properties in general is described and applied to typical combustion MHD generator plasmas. This section also includes a collection of momentum transfer cross-sections for collisions between electrons and heavy particles typical of seeded combustion gases. The next section presents the treatment of turbulent boundary layers and closely related phenomena such as wall friction, heat losses and electrode drops. In the last section, these methods and data are applied to the calculation of real combustion MHD flows. The main part of this section presents the numerical methods used in our computer program and typical results. (auth)

General Detectors and Monitors

Refer also to abstracts 18083, 18544, 19048, 19094, 19797, 19910, 20065, and 20077.

18399 (RFP-2136) SINGLE SCINTILLATION CRYSTAL VERSUS PHOSWICH DETECTORS FOR IN VIVO LOW-ENERGY PHOTON DETECTION. Tyree, W. H. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 7 Jan 1974. Contract AT(29-1)-1106. 15p. Dep. NTIS $4.00.

The development of in vivo body-count measurement systems for the detection of low-energy photons from americium and plutonium has stressed the importance of low background counting rates for better sensitivity. The measurement systems are developed for use in the body-counting facility, which has been in operation at the Rocky Flats Plant, to detect exposures in humans from radioactive materials. The facility is in a separate building and houses the body counter which consists of thick steel walls. The detectors within the body counter section are arranged over a table or couch and can be positioned over various parts of the body of an individual being checked for the presence of radioactive materials. The systems in current use provide an improvement in background counting rates for sodium-iodide thallium detectors with the two-crystal sandwich or Phoswich scintillator. The two types of electronic configurations used with the Phoswich detectors demonstrate improvements in background counting rates over results from a single crystal detector. Tabulated data comparing the operating parameters of a single crystal and a dual-crystal configuration are included. (auth)

18400 (RT/FI-(73)35) ACTIV CODE. Bozzi, L.; Caporella, F.; Cosimi, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Oct 1973. 31p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.75.

The ACTIV code, a FORTRAN IV program for the IBM 360/75 for calculating the activities of sandwich detectors is described. The effect of scattering with energy degradation in the filter and in the detectors has been included to a first approximation. (auth)

18401 (SLA-73-978) COMPTON DIODE DEVELOPMENT PROGRAM. Conrad, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 23p. Dep. NTIS $3.25.

Compton diodes (CD's) have been used for a number of years for diagnostic gamma measurements. About 1965 the demand increased for their use as gamma sensors to trigger oscilloscopes on nuclear tests at the Nevada Test Site. This report covers the steps taken in developing the Mod 3 family of low-cost CD's for trigger signal sensors. They have also been used successfully on pulse reactor and pulsed x-ray facilities, and the smaller units are suitable for making diagnostic measurements. (auth)

18402 RADIOCAPSULE FOR RECORDING IONIZING RADIATION IN THE GASTROINTESTINAL TRACT. Gunin, Yu. Ya.; Kalantarov, K. D.; Pluzhnikov, V. M.; Zemskov, V. P.; Semenov, V. S. Med. Tekh.; 1: 21-25(1972). (In Russian).

For measuring radioactivity in the stomach (due to ^{32}P-labeled erythrocytes previously administered), a probe is introduced through the nose or mouth, on which is mounted a detector that is connected through leads to an external recording device. The detector found most satisfactory was a specially designed Geiger-Mueller counter with a miniaturized low-voltage hemispherical counter. Diagrams are presented showing the electronics of the device and examples of the recordings obtained. The use of the method for diagnosing hemorrhages or malignancies is described. (TTT)

18403 BASIC PARAMETERS AND DETECTION PROPERTIES OF ANGER PHO/GAMMA HP SCINTILLATION CAMERAS. Husak, V.; Kleinbauer, K. (Palackeho Univ., Olomouc, Czech.). Cesk. Radiol.; 27: No. 4, 269-277(Jul 1973). (In Czech).

The intrinsic resolution of the detectors of Pho/Gamma HP cameras and the sensitivity and resolution of two new collimators for scintigraphy with low-energy emitters were measured using linear and planar gamma sources. At the energy of 140 keV, the intrinsic resolution is better by 20% than that of the camera Pho/Gamma III. The sensitivity of the high-sensitivity collimator is twice that of the 4000-hole collimator; therefore it is especially suitable for dynamic examinations. The penetration of gamma rays through partitions between holes is rather high in the new collimators; in estimating the resolution, the modulation transfer function was therefore employed. These collimators permit an optimum adaptation of the camera detector to the examination conditions, to the activity applied, and to the sort of diagnostic information required. (auth)

18404 STUDIES IN COLLIMATOR AND SCANNER PERFORMANCE. III. Response to Line Sources. John, R.; Bhardwaj, V. P. (Inst. of Mathematical Sciences, Madras). Indian J. Radiol.; 26: No. 1, 12-17(Feb 1972).

The response of 9-hole and 19-hole collimator-detector systems to line sources of various isotopes is described. A comparison of point source and line source response has been made. The isotopes selected for the experiments are ^{203}Hg (280 keV), ^{131}I (364 keV), ^{198}Au (420 keV), ^{137}Cs (660 keV), and ^{59}Fe. The computation of the modulation transfer function (MTF) from the observed line source response and the evaluation of collimator performance by the MTF are discussed. (INIS)

18405 AMPLITUDE DISCRIMINATOR BASED ON A TUNNEL DIODE FOR SCINTILLATION COUNTERS. Golenetskii, S. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1110-1111(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 109-110(1973).

A sensitive current-pulse amplitude discriminator is described which is implemented according to a flipflop circuit based on an inverted tunnel diode and is designed for connection directly into the anode circuit of a photomultiplier. The sensitivity and stability of the circuit are sufficient for its use in scintillation counters designed for low-energy measurements with fast scintillators. (auth)

18406 POLYETHYLENE VESSEL FOR LIQUID SCINTILLATION COUNTERS. Gaevoi, V. K.; Tokarev, G. L.; Romashova, L. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1086-1087(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 87-89(1973).

The construction of a polyethylene vessel with windows made of polyethylene film is described along with the technology of its fabrication. Certain characteristics of the vessel are presented. The vessel is designed for performing measurements on the Medik URB-1 installation with a liquid scintillator. (auth)

18407 SIMPLE METHOD FOR MEASURING THE ENERGY EQUIVALENT OF THE NOISE OF SEMICONDUCTOR NUCLEAR RADIATION DETECTORS. Zakharchuk, O. V.; Il'in, A. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1071-1073 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 75-77(1973).

A method is considered for determining the energy equivalent of the noise of semiconductor nuclear-radiation detectors which is based on calibrating a simplified measurement device consisting solely of a spectrometric preamplifier and a vacuum-tube voltmeter. The method allows a considerable increase in the speed of the measurements and permits their cost to be lowered. (auth)

18408 SCINTILLATION DETECTOR WITH SEMICONDUCTOR SILICON PHOTODIODES HAVING A p-i-n STRUCTURE. Medve-

dev, M. N.; Kondratenkov, Yu. B.; Kondratenkova, L. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1074-1076(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 77-79(1973).

A scintillation detector using a semiconductor silicon photodiode with a p–i–n structure is described. The sensitivity of the detector with a classic scintillator 40 mm in diameter and 100 mm high is 2×10^{-16} A · cm^2 · sec/MeV for a photodiode bias voltage 1 kV. The detector time resolution is <10 nsec. (auth)

18409 LUMINESCENCE KINETICS OF SCINTILLATORS. Medvedev, M. N.; Kondratenkov, Yu. B. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1077-1079(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 79-81(1973).

The flare-up time of light flashes in NaI(Tl) (6 ± 0.5 nsec) and CsI(Tl) (22 ± 1 nsec) crystals and the duration of the fast and slow components of the light flashes in mixed crystals based on naphthalene are measured for irradiation of the crystals with the single x-ray pulses. It was established that the luminescence of crystals can be described by two exponentials having the constants 3.6 ± 0.5 and 114 ± 7 nsec for naphthalene + diphenylbutadiene, 4.2 ± 0.5 and 18 ± 2 nsec for naphthalene + anthracene, and 4.6 ± 0.5 and 53 ± 3 nsec for napthalene + anthranyl acid. (auth)

18410 ZnS + B SCINTILLATION COUNTER: A THRESHOLD DETECTOR FOR A PULSED FLUX OF FAST NEUTRONS. Kolesov, B. M.; Ovchinnikov, A. K.; Khaikovich, I. M.; Ganichev, G. I.; Timofeeva, T. V.; Podpoyaskin, V. A.; Gubanov, V. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1080-1082(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 82-84(1973).

A threshold detector is described for measurement of a flux of neutrons having an energy of 14 MeV from a pulsed neutron generator. The detector was a ZnS + B scintillation counter that uses a $^{11}B\ (n,\alpha)^8Li \rightarrow 2\alpha + \beta^-$ reaction. For a detector having the dimensions 30 × 50 mm a sensitivity of 6800 pulses/min/10^6 neutrons/sec was achieved. The detector was used for continuous recording of the neutron flux in activation analysis of elements in moving media. (auth)

18411 HELIUM COUNTERS IN A MODERATOR FOR THE DETECTION OF NEUTRONS. Shapar, A. V.; Efimenko, V. F. (Physics-Power Inst., Obninsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1055-1056(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 63-64(1973).

A neutron detector is described for spectrometry based on the time-of-flight method. The detector consists of 120 SNM-43 helium proportional counters that are placed in a polyethylene block. The area of the working surface of the detector is 2500 cm^2, and the resolving time is 2 to 3 μsec. The neutron-recording efficiency in the range from 30 eV to 200 keV varies smoothly from 10 to 6.3%. (auth)

18412 ESTIMATING THE EFFICIENCY OF OPEN IONIZATION COUNTERS IN THE DETECTION OF EXOELECTRONS AND PHOTOELECTRONS. Gel'man, A. G.; Tolkachenko, G. A. (Odessa Technological Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1057-1059(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 64-66(1973).

A procedure is advanced which allows the number of discharged particles in open gas-discharge counters to be used to estimate the number of electrons leaving the surface of a solid during the process of exoelectronic and photoelectronic emission. (auth)

18413 ESTIMATION OF THE LINEARITY OF THE WORKING CHARACTERISTIC OF IONIZATION CHAMBERS. Dmitriev, A. B.; Shepel, V. S. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1060-1062(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 67-68(1973).

A procedure is described which allows estimation of the linearity of the working characteristic of ionization chambers according to the slope of the volt-ampere characteristic. (auth)

18414 THREE ELECTRODE GEIGER–MUELLER COUNTERS WITH A CONTROLLABLE SENSITIVITY. Dmitriev, A. B.; Kondrasheva, E. P.; Filatov, A. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1053-1054(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 61-62(1973).

The principal parameters of industrial three-electrode Geiger–Mueller counters with smooth control of the sensitivity are considered. The sensitivity of the instruments can be varied at least by a factor of 2 by applying a controlled positive potential to a specially introduced control electrode. (auth)

18415 ANALYSIS OF METHODS FOR MEASURING NEUTRON FLUX IN THE PRESENCE OF GAMMA RADIATION. Kazachkov, V. I. (State All-Union Central Scientific-Research Inst. of Complex Automation, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1032-1034(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 45-47(1973).

The metrological characteristics (sensitivity, measurement range, etc.) of three methods for measuring neutron flux in the presence of γ radiation are considered. The methods include measurement of the average detector ionization current using the compensation method, counting of the ionization-current pulses of the detector using the amplitude method, and measurement of the dispersion of the detector ionization current using the statistical method. A comparison is made of the methods with respect to sensitivity and measurement ranges for a stipulated error; numerical examples of the calculation are given. (auth)

18416 COMMENTS ON THE CAPTURE CROSS SECTION OF ELECTRONS IN SILVER BROMIDE GRAINS. Sharma, A. P. (Kurukshetra Univ., India); Sharma, G. P. Pramana; 1: No. 4, 196-203(Oct 1973).

The values in the range of 10^{-15} cm^2 to 10^{-14} cm^2 have been reported by various authors for the capture cross section of electrons at the traps in silver bromide grains. In this paper a suitable value of this cross section is given which is used for computing the track characteristics in nuclear emulsions (e.g., effective ionization, probability of development, grain density, and mean gap length) and the ratio of the rate constant of recombination and trapping. Theoretical results agree well with the experimental observations and the available data of other workers, and give a convincing support to the choice of this cross-section parameter. (auth)

18417 INFORMATION TRANSMISSION CAPACITY OF GAMMA IMAGING DEVICE. Korppi-Tommola, T.; Riihimaeki, E.; Vauramo, E. (Helsinki Univ. Central Hospital). Phys. Fenn.; 8: No. 1, 117-122(May 1973).

A method is described to quantitate the total information transmission capacity of gamma imaging devices in such a way that both the spatial and intensity information are included. This allows objective comparison of different systems under different operating conditions. Under clinical conditions the scanning range of capacities is found to be in the range from 200 to 600 bits. It is found that better spatial resolution increases the information transmission capacity in a more significant way than a large number of counts in the image. (auth)

18418 EFFECT OF POLYETHYLENE GLYCOL ON THE STABILITY OF NUCLEAR EMULSIONS OF LOW SENSITIVITY. Novikova, N. R.; Kalyamina, G. V. Zh. Nauch, Prikl. Fotogr. Kinematogr.; 18: No. 5, 372-374(1973). (In Russian).

The stability of latent image centers formed by charged particles in specially small-grained emulsions of type P9$_3$ of low sensitivity and the effect of polyethylene glycol development were investigated. The emulsions were irradiated with α particles and protons. The results showed that the use of developers containing polyethylene glycol guarantees the stability of the registering properties. (JSR)

18419 IMPROVEMENTS IN AND RELATING TO METHODS OF MANUFACTURING AN ELECTRICAL COMPONENT. Shannon, J. M. (to Mullard Ltd.). British Patent 1,336,846. 14 Nov 1973. Filed Date 19 Nov 1969. 25p.

In the method described a substrate provided with a thin metal layer is bombarded with ions to cause atoms from the metal layer to become implanted in the surface of the substrate, whereby its electrical characteristics are changed. At least part of the metal layer is retained to form an electrode connection. The metal layer may be composed of Al, Sb or Ge, and the ions may be those of an inert gas, such as Ar or Kr, having energies in the range 10 to 160 keV. The substrate may be a semiconducting material such as Si, and the manufactured semiconductor device may comprise a Schottky barrier diode. The implanted atoms may be those of an impurity element characteristic of one conductivity type of the semiconductor body material. Application to radiation detecting or measuring devices is also described, making use of a radiation-sensitive p-n junction. Masking layer patterns may be used. Other applications include the production of p-n junction diodes, insulated gate field-effect transistors, bipolar transistors, integrated circuits, etc. (UK)

18420 ETCHING BEHAVIOR OF A CELLULOSE NITRATE PLASTIC DETECTOR UNDER VARIOUS ETCHING CONDITIONS. Enge, W.; Grabisch, K.; Beaujean, R.; Bartholmae, K. P. (Univ., Kiel). Nucl. Instrum. Methods; 115: No. 1, 263-270(1974).

To study the etching mechanism of cellulose nitrate (Daicel, Japan) the etching parameters have been varied. Different etchants (LiOH, NaOH, KOH) at various concentrations between 1 and 15 normality have been used at different temperatures between 15°C and 50°C. The effects of stirring the etchants and interrupting the etching process have been studied. The bulk etching behavior

of cellulose nitrate depends on the normality, the temperature and the stirring of the etchant. The track etching rate of cellulose nitrate is independent of mechanical stirring. The threshold of the detector and the charge and isotopic resolution were determined for the different track etching rates. A higher resolution is accompanied by a higher threshold. (auth)

18421 UTILIZATION OF INTERNAL PAIR FORMATION FOR MULTIPOLARITY ANALYSIS. Pepelnik, R.; Fanger, U.; Michaelis, W. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 115: No. 1, 285-295(1974).

The combination of semiconductor detectors with a superconducting solenoid offers the possibility to construct a high-resolution spectroscopic instrument which collects the positron-electron pairs from internal pair formation with high detection efficiency. Response characteristics and multipole discrimination power are given for the most suitable detection geometries and are compared with the capabilities of internal conversion electron spectroscopy. The results show that for multipolarity analysis of high-energy nuclear transitions internal pair spectrometry may be a superior method in the low- and intermediate-Z region. The calculations are based on the zero-order Born approximation (ZBA). A comparison of the ZBA total pair production coefficients with exact Coulomb wave function solutions of the Dirac equation suggests that the results are sufficiently accurate at least for $k > 3$ and $Z < 50$. (auth)

18422 IDENTIFICATION OF FISSION ACTIVITY USING THIN-FILM DETECTORS. McDonald, W. J.; Kilvington, A. I.; Batty, C. J.; Weil, J. L. (Rutherford Lab., Chilton, Eng.). Nucl. Instrum. Methods; 115: No. 1, 185-188(1974).

A method to measure the masses of fission fragments from spontaneously fissioning sources using thin plastic-scintillator film detectors is described. The method has been tested for a ^{252}Cf source and would appear to have significant advantages—in particular higher efficiency—for experiments using very low counting rates. (auth)

18423 RADIATION-ACTIVATED SENSOR. Nirschl, J. C. (USAECOM, Ft. Monmouth, NJ). Nucl. Instrum. Methods; 115: No. 1, 173-180(1974).

A MOSFET discriminator is described as the key circuit element for a recycling ion-chamber discharge system, the power demand of which varies with the signal (radiation) level. The radiation detector is a miniature ion chamber, compatible with the circuit battery voltage. Two discharge methods are discussed, as well as an adaptation of the recycling circuit to photoelectronic sensing. (auth)

18424 CALIBRATION PROCEDURE FOR THE RESPONSE OF SILICON SURFACE-BARRIER DETECTORS TO HEAVY IONS. Kaufman, S. B. (Argonne National Lab., IL); Steinberg, E. P.; Wilkins, B. D.; Unik, J.; Gorski, A. J.; Fluss, M. J. Nucl. Instrum. Methods; 115: No. 1, 47-55(1974).

The response of silicon surface-barrier and other semiconductor detectors to heavy ions is complicated by the presence of a pulse-height defect, such that heavy ions produce a smaller pulse height than lighter ions of the same kinetic energy. Based on the results of measurements of this phenomenon with a variety of ions, a new calibration technique for such detectors is proposed. Unlike the widely used calibration technique proposed by Schmitt and coworkers, which assumes the pulse-height response to be linear in both mass and kinetic energy, the present procedure reproduces the observed non-linearities. It is based on separating the energy of the ion into two terms, one of which is strictly proportional to the pulse height and is, in fact, the energy which a light ion, such as an alpha particle, must have to give the same pulse height. The second term is the energy defect of the ion, and is a function of its kinetic energy, mass and atomic number. Applications of the technique to experimental data are presented, including energy and time-of-flight mass measurements of energy-degraded fission fragments, and double-energy measurements of the fissioning systems $^{235}U(n,f)$ and $^{252}Cf(sf)$. (auth)

18425 TIMING WITH THIN-FILM DETECTORS IN A PERTURBED ANGULAR CORRELATIONS EXPERIMENT. Brenn, R.; Sprouse, G. D. (State Univ. of New York, Stony Brook). Nucl. Instrum. Methods; 115: No. 1, 57-60(1974).

Thin-film particle detectors in connection with NaI detectors have been used to measure time-differentially the perturbed particle-gamma angular correlation of projectile-excited $^{19}F-(5/2^+)$ in electric field gradients using a ^{19}F beam from a tandem accelerator. The technique applied uses implantation of the excited projectile through vacuum. It results in a strong polarization of the nuclear state by the Coulomb excitation process which in connection with a noncubic single crystal is used to determine sign and magnitude of the electric quadrupole interaction. (auth)

18426 DELAYED COINCIDENCE MEASUREMENTS USING SEMICONDUCTOR DETECTORS. Bishop, R. J. (Kingston Polytechnic, Eng.). Nucl. Instrum. Methods; 115: No. 1, 61-64(1974).

The use of semiconductor detectors in delayed coincidence measurements of short nuclear half-lives is considered. Their use is illustrated by an accurate measurement of the half-life of the 86.5 keV excited state in ^{233}Pa. A result of (37.7 ± 0.2) ns was obtained. The result of a measurement of the half-life of the 59.6 keV level in ^{237}Np is also reported. The value obtained was (68.5 ± 0.4) ns. Both these results are in good agreement with previous recent determinations. (auth)

18427 CORRECTION TO THE KURZ NEUTRON DETECTOR EFFICIENCY CODE. Elbakr, S. A.; Watson, J. W.; Miller, C. A. (Univ. of Manitoba, Winnipeg). Nucl. Instrum. Methods; 115: No. 1, 115-116(1974).

A correction to the plastic scintillation neutron detector efficiency code of Kurz is described, and a comparison of results before and after correction is presented. (auth)

18428 FISSION-TRACK REGISTRATION IN SOLID-STATE TRACK DETECTORS IMMERSED IN FISSILE-MATERIAL SOLUTIONS. Iyer, R. H.; Sampathkumar, R.; Chaudhuri, N. K. (Bhabha Atomic Research Centre, Trombay, India). Nucl. Instrum. Methods; 115: No. 1, 23-27(1974).

Fission-track registration characteristics of some solid-state track detectors immersed in aqueous solutions of fissile materials have been studied. The track density registered on the detector is related to the number of fissions occurring per unit volume of the solution of fissile material. In view of the many possible applications of fission-track registration in solution, the factor, K_{wet}, which gives a measure of the track-registration efficiency in solution and which directly relates the measured track density to the total number of fissions occurring per unit volume of a given solution of the fissile material, has been determined for some of the common track detectors. The values of K_{wet} for Lexan, Makrofol-E, Melinex-O and Mica are (8.1 ± 0.2) 10^{-4} cm, (6.1 ± 0.1) 10^{-4} cm, (8.9 ± 0.3) 10^{-4} cm, and (7.8 ± 0.2) 10^{-4} cm, respectively. Preliminary studies on the effect of neutron irradiation of the detectors on the values of K_{wet} have been carried out, and there is a general decrease in the value of K_{wet} for irradiated plastics compared to non-irradiated plastics. The usefulness of this factor in the development of a versatile neutron-flux monitor and for the determination of absolute fission yields is discussed. (auth)

18429 FAST NEUTRON SPECTRA IN STANDARD SEED IRRADIATION FACILITIES FOR TRIGA REACTORS. Krajnik, J.; Najzer, M.; Pauko, M.; Rant, J. (Univ. of Ljubljana, Yugoslavia). vp. (SM-179/14).

From symposium on the effects of neutron irradiation upon cell function; Nuremberg, Germany (22 Oct 1973).

The measurement of fast neutron spectra in the Standard Seed Irradiation Facilities for TRIGA reactors with the help of threshold detectors is described. Nine different threshold detectors with threshold energies between 0.7 and 12 MeV are used, and the induced activities are detected by a calibrated NaI(Tl) scintillation spectrometer. (GE)

18430 ROUTINE CHECKING IN LIQUID SCINTILLATION SPECTROMETERS FOR THE MEASUREMENT OF ^{3}H, ^{14}C, AND ^{32}P. Huelsen, W.; Gabard, M. (Kernforschungszentrum, Karlsruhe, Ger.). Atomkernenergie; 22: No. 2, 98-101(Oct 1973). (In German).

A series of controls are described by which the electric and electronic functions of a liquid scintillation spectrometer can be monitored. Furthermore, it is possible to confirm by this and other controls, the correct adjustment of the instrument variables for a certain measuring problem. (GE)

18431 SELECTION OF CONSTRUCTION ELEMENTS FOR A QUANTOMETER FOR MEASUREMENT OF INTENSITY OF BREMSSTRAHLUNG WITH MAXIMUM ENERGY FROM 0.55 TO 25 MeV. Golikov, E. G.; Dvinyaninov, B. L.; Sukhanova, K. A.; Maiorov, V. N. pp 75-78 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Tests to evaluate the minimum radiation energy which can be measured with the quantometer were made. Transition curves for Cu absorbers for monoenergetic radiation sources of ^{141}Ce ($E\gamma$ = 0.145 MeV), ^{137}Cs ($E\gamma$ = 0.66 MeV), and ^{60}Co ($E\gamma$ = 1.25 MeV) and bremsstrahlung spectral curves for a betatron with energy from 10 to 25 MeV were calculated. On the basis of the analysis of the experimental curves a calculation was made for the quantometer. The results obtained indicated that this quantometer can measure γ quanta with a minimum energy of 0.5 MeV. (tr-auth)

18432 USE OF DIFFERENTIAL IONIZATION CHAMBER FOR DETERMINATION OF GAMMA ACTIVITY AND MEASUREMENT OF DOSE FIELD OF SPENT FUEL ELEMENTS OPERATING IN THE TRANSIENT REGIME. Dunaev, L. M.; Krozdov, V. E. pp 78-84 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

It was shown that fuel elements operated in the transient regime have identical decay curves to those from reactors operated in the steady regime. For determination of the effective operated time of the fuel elements in reactors in the stationary regime (T_{eff}) a differential ionization chamber, consisting of two chambers, was used. The measuring chamber was placed near the fuel elements and the compensation chamber was placed on the other side with a ^{60}Co source. The proposed measurement plan was used for the simultaneous determination of the absolute activity of the fuel element isotopes and the value of T_{eff} after 30 min. Experimental data on the measurement of the dose field from the fuel elements with non-uniform distribution of the activity with respect to the height and angle in the fuel element were also reported. It was shown that this method can be used for the dosimetry of other sources. (tr-auth)

18433 PHOTO- AND RADIOLUMINESCENCE OF PLASTIC FILM SCINTILLATORS IRRADIATED WITH GAMMA RAYS. Zhelinskaya, G. V.; Sizyikh, A. G. pp 147-152 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A polystyrene-based system with additions of the organic luminophors PPO and POPOP was investigated. With increase of the temperature the rate of degradation of the radioluminescence increases, but with increase of the dose rate it is decreased. During photo-luminescence the degree of the temperature effect depends on the wave length of the exciting light and the concentration of the additions. Comparison of the results obtained on the photoluminescence and radioluminescence in poly(vinyl chloride) shows the difference in the concentration of oxidation products on the surface and in the film depths which is one of the reasons for the difference in the degradation rate. (tr-auth)

Radiation Dosimeters

Refer also to abstracts 18197, 18610, 19040, and 19041.

18434 (CLOR-96) SENSITOMETRIC TESTING OF FILM DOSIMETERS. Smoniewski, J. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). 1973. 27p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.50.

The results of sensitometric tests carried out on the basis of the recommendations in the paper "Preliminary Work for Establishing the Method of Sensitometric Testing of Film Dosemeters", worked out at the Central Laboratory for Radiological Protection are given. Sensitometric indices were determined for the films produced by FOTON – Poland, ORWO – East Germany, AGFA – GEVAERT – West Germany and KODAK – USA. From the films irradiated with ^{60}Co gamma radiation, sensitometric indices concerning optical density, fog, contrast, and sensitivity as well as the range of measurements by characteristic curves were determined. (auth)

18435 (ORNL-TM-4441) RESULTS OF ORNL MEASUREMENTS MADE DURING THE INTERNATIONAL NEUTRON DOSIMETRY INTERCOMPARISON, MARCH 19–30, 1973. Dickson, H. W.; Christian, D. J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

The Radiation Research and Development Section of the Health Physics Division at ORNL participated in the International Dosimetry Intercomparison (INDI) on March 19 through 30, 1973, at the Brookhaven National Laboratory. The intercomparison measurements were made at the Radiological Research Accelerator Facility (RARAF) which is operated by Columbia University. Several laboratories participated; however, only the results of the ORNL group are presented. At the RARAF a 4-MeV Van de Graaff accelerator was used to produce neutrons of several different energies, and a nominal 2-mg californium-252 source was used. The measurements included both neutron and gamma-ray kerma in air for each of the sources and absorbed dose in a water-filled phantom for 15.4- and 5.55-MeV neutrons. Gamma-ray kerma and absorbed dose rate measurements were made using a "Phil" Geiger counter, and neutron kerma and absorbed dose rates were measured with an in-phantom Hurst proportional counter. Intercomparison data are given and discussed. (WHK)

18436 PHOSPHATE GLASS DOSIMETRY. Regulla, D. F. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Arch. Tech. Mes. Messtech. Praxis; 449: No. 6, 105-108(1973). (In German).

The measurement principle; dosimeter material; measurement range; dose rate dependence; photon energy dependence; directional dependence; temperature behavior; sensitivity to photons, electrons and neutrons; measurement device; method; and accuracy are briefly reviewed. (GE)

18437 KALORIMETRIYA IONIZIRUYUSHCHIKH IZLUCHENII. (Calorimetry of Ionizing Radiation). Shimanskaya, N. S. Moscow; Atomizdat (1973). 328p.

Calorimetric methods for the investigation and measurement of ionizing radiation are discussed. The general principles of the methods, the different types of calorimetric installations, and methodic questions connected with their use are examined. Questions of the use of calorimetric methods for the measurement of the absolute activity of radioactive preparations and determination of the spectrometric characteristics and half lives of radioactive isotopes are discussed in detail. Calorimetric measurements on accelerators and reactors and the use of calorimetry in dosimetry, radiation chemistry, and radiation physics are also considered. (tr-auth)

18438 NEUTRON DOSIMETRY AND SPECTROMETRY METHODS USED IN CELL MUTATION EXPERIMENTS. Holt, P. C.; Boot, S. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). vp. (SM-179/14).

From symposium on the effects of neutron irradiation upon cell function; Nuremberg, Germany (22 Oct 1973).

Calculation and measurement methods are described that make it possible to determine absorbed doses. Neutron dosimetry is done with ionization chambers and fission chambers, while spectrometry methods use proton radiator spectrometers and ^{3}He proportional counters. Spectrum measurements are necessary to calculate the sensitivity factors of the fission chambers and to determine the absorbed dose, from the fluence as well as from the ionization chamber measurements. (GE)

18439 EVALUATION OF PERSONAL FILM DOSIMETERS BY COMPUTER. Bojtor, I. (Orszagos Frederic Joliot–Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest); Illes, A. Izotoptechnika; 16: No. 12, 679-683(Dec 1973). (In Hungarian).

Evaluation of RPS/AERE dosimeters by computer with a 20% maximum error in exposition dose determination is described. (auth)

18440 DOZIMETRIYA I RADIATSIONNYE PROTSESSY v DOZIMETRICHESKIKH SISTEMAKH. (Dosimetry and Radiation Processes in Dosimetric Systems). Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). 252p.

Separate abstracts were prepared for the 55 papers presented. (WHK)

For abstracts of individual papers see: 18195–18197, 18431–18433, 18441–18469, 18504, 18521–18523, 18543, 19039–19041, 19052, 19053, and 19899–19908.

18441 METROLOGICAL GUARANTEE AND STANDARDIZATION OF MEASUREMENT OF ABSORBED AND EXPOSURE DOSE OF INTENSE BEAMS OF IONIZING RADIATION. Bregadze, Yu. I.; Generalova, V. V. pp 3-7 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

With the purpose of guaranteeing the units in the dose measurement of different forms of radiation in the interval from 10^2 to 10^9 rad the establishment of calibrated apparatus, standard means of dose measurement for the control of dosimeters, and development and approval of necessary standard technical documentation are proposed. As standard means for the measurement of the absorbed dose in the range from 10^3 to 10^5 rad Frick dosimeters and glucose dosimeters are recommended. These guarantee the dose measurement with an error no greater than 7%. Glass detectors CGD-8 and visual light indicators are recommended in the dose region from 0.2×10^6 to 5×10^6 rad. It is advisable to standardize the common technical requirements to chemical dosimeters and the certification methods according to the dose exposure rate of series-graduated radiation installations. (tr-auth)

18442 DOSIMETRY DURING RADIATION PROCESSES USING INTENSE ELECTRON BEAMS WITH ENERGY FROM 1 TO 10 MeV. Dmitriev, A. K.; Kon'kov, N. G.; Kryiov, S. Yu. pp 57-59 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The dosimetry of a beam of accelerated electrons with energy from 1 to 10 MeV was realized with the film dosimeters of polymethylmetacrylate and polyvinylchloride. The calibration of the

dosimeters was done with total absorption calorimeters. The depth distribution of the absorbed dose and a method for the uniform irradiation of the heterogeneous system during radiation modification of tissues and the sterilization of medical products were studied. (tr-auth)

18443 ADIABATIC DIFFERENTIAL CALORIMETER FOR MEASUREMENT OF ABSORBED DOSE OF AN INTENSE BEAM OF ACCELERATED ELECTRONS. Dmitriev, A. K.; Kon'kov, N. G.; Krylov, S. Yu. pp 59-62 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The construction of a calorimeter designed for the measurement of the local absorbed dose in tissue-equivalent media irradiated by a beam of accelerated electrons with energy from 1 to 10 MeV is described. The method of measurement of the absorbed dose was reduced to the comparison of the temperature change in the absorber under the effects of radiation with the temperature change produced in a control calorimeter with Joule heat. The calorimeter was proposed for use during calibration of film dosimeters in the dose rate range from 10 to 100 krad/sec. The calculated error of the absorbed dose measurement is 1%. (tr-auth)

18444 GAS DOSIMETRY OF REACTION CHAMBER DURING RADIATION-CHEMICAL PROCESSES UNDER EFFECTS OF ACCELERATED ELECTRONS. Krutetskaya, O. N.; Orlova, N. E.; Panin, Yu. A.; Upadyshev, L. B. pp 68-71 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A flow sheet for carrying out gas dosimetry using nitrous oxide during irradiation with accelerated electrons is presented. Experimental results were obtained under different accelerator regimes. From the gas dosimetry data the mean-volume values of the absorbed dose intensity in the chamber were calculated. By means of film dosimeters the distribution of the intensity of the absorbed dose was determined along the chamber axis. The data of the common methods are compared. (tr-auth)

18445 CLINICAL DOSIMETRY OF PROTON BEAMS OF HIGH PULSE INTENSITY. Blokhin, S. I.; Kleinbok, Ya. L.; Lomanov, M. F.; Narinskii, V. M.; Khoroshkov, V. S.; Shimchuk, G. G. pp 71-75 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A method for the measurement of the dose field during radiation therapy with intense accelerator proton beams was investigated and developed. The circuits are described. The operating characteristics of the original system for the monitoring of the proton beam are reported. A method is given for the measurement of the longitudinal and transverse dose distribution with a precision of ±10%. It was found that the radiation burden on the body of patients with consideration of the quality coefficient is 0.5% of the dose in the irradiation center during irradiation with 155-MeV protons. The total error in the determination of the dose field of the system described does not exceed 15%. (tr-auth)

18446 METROLOGICAL VERIFICATION OF STATUS OF MEASUREMENT OF GAMMA-RADIATION DOSE FROM 1×10^3 TO 1×10^8 RAD WITH LIQUID CHEMICAL DETECTORS. Bratanovskii, V. V.; Generalova, V. V.; Gurskii, M. N.; Tultaev, A. V. pp 100-103 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A metrological verification was made of the measurement of the exposure and absorbed dose in the range from 10^3 to 10^8 rad in 14 organizations. It was shown that in 38% of the measurements, values of the exposed dose were obtained that were too low; values were overestimated in 62% of the cases. This documents the unsatisfactory status of the measurement of the γ radiation dose. Recommendations were given on the standardization of the preparations and dose measurement in liquid dosimetric systems. (tr-auth)

18447 ACCURACY IN USE OF FILM-DOSIMETRIC SYSTEMS FOR DOSIMETRY OF GAMMA AND ELECTRON FIELDS. Blaunshtein, I. M.; Kishinevskaya, M. B.; Rakhimbaeva, N. U. pp 107-110 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A study was made of the dependence of the basic dosimetric parameters of film polymer dosimeters (optical density) on the thickness of the film. It was shown that in films of polyethylene, poly(vinyl chloride), and poly(methyl methacrylate) with dyes the radiation effect has a volume character. The determination of the absorbed dose using these films in a wide interval of thicknesses can be made by a standardized calibrated curve whereas the use of films of polystyrene, poly(methyl methacrylate), and cellulose triacetate require consideration of the film thickness. (tr-auth)

18448 USE OF FILM POLYETHYLENE DOSIMETERS FOR CONTROL OF GAMMA IRRADIATION OF POLYETHYLENE WIRES. Blaunshtein, I. M.; Zolotarevskaya, F. T.; Ikramov, A. G. pp 110-112 of Dozimetriya i Radiatsionnye Protsessy v Dosimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

It was shown that polyethylene dosimeters achieve simultaneously both dosimetric and technological control. The calibrated dose dependence of the polyethylene absorption spectrum and the ratio of the concentration of C=C and C=O bonds at different oxygen concentrations in the irradiation atmosphere were obtained. (tr-auth)

18449 LIGHT INDICATORS FOR VISUAL EVALUATION OF DOSE DURING RADIATION STERILIZATION. Grammatikati, V. S.; Grinev, M. P.; Ershova, Z. F.; Kozlov, L. L.; Litvinova, T. G.; Mikhailov, L. M.; Molin, A. A.; Panchenkov, G. M. pp 113-118 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A proposal was made to use plasticized poly(vinyl chloride) films with acid-sensitive dyes inserted in them for light indicators of dose in the range from 0.1 to 5.0 Mrad. The sensitivity of the indicators to radiation was determined as a function of the film composition and the dye used. A calibration was made of the light indicators by means of the ferrosulfate method and calorimetry. A method was proposed for the instrumental control from the color change of the indicators by means of the spectrophotometry of irradiated samples which makes it possible to measure doses with an error of ±10 to 12%. Practical recommendations were given for the use of the light dose indicators during the control of radiation sterilization. (tr-auth)

18450 USE OF RIGID PVC PLASTIC AND VINIPROZ AS FILM DOSIMETERS IN THE DOSE RANGE FROM 5×10^4 TO 10^7 RAD. Litvinova, T. G.; Grinev, M. P.; Grammatikati, V. S.; Mikhailov, L. M.; Margolina, G. F. pp 118-122 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The possibility of using film material based on poly(vinyl chloride) with different concentrations of plastizer (rigid PVC plastic) and copolymer of poly(vinyl chloride) with poly(methyl methacrylate) (viniproz), commercially manufactured, for dosimetry in the dose range from 5×10^4 to 10^7 rad was investigated. For compensation of the post effect, thermal treatment of the irradiated films at different temperatures (40 to 70°C) for 4 to 8 hrs was proposed. The results obtained for different forms of irradiation (γ, electron, and x-ray), energy, and dose rate were compared. The use of calibrated graphs, corresponding to the concrete irradiation parameters, were recommended for making dosimetric measurements. The use of poly(vinyl chloride)-based polymer films was proposed for the measurement of dose distribution and periodic control of the uniformity of the irradiation conditions in radiation sterilization processes. (tr-auth)

18451 RADIATION-CHEMICAL TRANSFORMATION IN PLASTIC SCINTILLATORS. Gurskii, M. N.; Zhelinskaya, G. V. pp 122-126 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Processes of radiation oxidation and destruction of polystyrene with additions of PPO, PPP, and POPOP were investigated by uv and infrared spectroscopy. A substantial increase in the optical density of the absorption bands, characteristic for oxidation products (carbonyl and hydroxyl groups), was found. The radiation chemical yield of the oxidation products of polystyrene increases with an increase of the temperature and decreases with increase of the dose rate. It was shown that during air oxidation of different compositions of the film plastic scintillators two interconnected processes were observed, i.e., oxidation and destruction. The role of PPO additions is reduced to amplification of these processes. (tr-auth)

18452 INVESTIGATION OF RADIATION DECOMPOSITION OF SOME ORGANIC LUMINOPHORS. Sizykh, A. G.; Miroshnikova, V. P. pp 126-130 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The kinetics of the radiation decomposition of the luminophors PPO and POPOP in polystyrene matrix and of PPO in the segregated state were investigated. It was shown that in the poly-

styrene matrix the relative change of the oxidation rate is larger in those cases where the relative change of the decomposition rate is higher. The effects of dose rate at comparative temperatures is reduced to a decrease of the oxidation rate of the base and decomposition of the luminophor. The decomposition process of the individual substances proceeds at a low yield. From comparison of the reaction rate of the PPO decomposition in polystyrene matrix and in the polycrystalline state it follows that the observed difference in the process rate (1.5 to 2 order) can be explained by the sensitization of the decomposition reaction of the addition by the oxidation products of the base. (tr-auth)

18453 USE OF CELLULOSE TRIACETATE FOR DOSIMETRY OF GAMMA RADIATION AT TEMPERATURES OF THE IRRADIATED MEDIUM FROM 20 TO 80°C. Aktabaeva, L. S.; Zyubko, V. A.; Terent'ev, B. M. pp 130-131 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The dependence of the optical density of commercial nonplasticized films of cellulose triacetate with a thickness of 140 ± 5 μ on the temperature of the irradiated medium was investigated in the interval from 20 to 80°C in the dose interval from 5 to 30 Mrad. The sensitivity of the film to irradiation temperatures greater than 40°C was established. The magnitude of the temperature correction was determined. (tr-auth)

18454 QUENCHING OF LUMINESCENCE IN THIN LAYERS OF ANTHRACENE DEPOSITED ON SOME METALS AND ALKALI HALIDE CRYSTALS DURING IRRADIATION WITH ^{60}Co GAMMA RAYS. Verkhgradskii, O. P.; Doroshenko, V. N.; Chervetsova, I. N. pp 132-135 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

With the purpose of investigating methods of dosimetry of finely dispersed heterogeneous systems, the degradation of the photoluminescence of thin layers (of the order of 1×10^{-4} to 3.2×10^{-3} mg/cm^2 layers) of anthracene during irradiation in contact with different metals and alkali halide crystals was studied. It was shown that as a function of the thickness of the layer and the form of the support, the degree of degradation of the photoluminescence was changed. The results obtained were explained by means of the theory of thimble chambers and the theory of molecular excitons. (tr-auth)

18455 QUENCHING OF ALPHA LUMINESCENCE AND RADIOLYSIS OF SOLID SOLUTIONS OF IMIDAZOLE DYES INCLUDED IN THE POLYMER BASE OF DOSIMETERS. Vainshtok, B. A.; Levchenko, N. F. pp 135-138 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The transfer of the excitation energy to the additions of halogen-substituted hydrocarbons was shown by radioluminescent methods in conjunction with the method of introduction of competing excitations acceptors. The regularities shown were used for the adjustment of the sensitivity of colorimetric dosimeters to x radiation. (tr-auth)

18456 RADIATION CONVERSION IN SOME INORGANIC LUMINOPHORS. Yunusov, M. S.; Grinchenko, G. P.; Sultanov, A.; Tsoi, A. N. pp 138-140 of Dozimetriya i Radiatsionnye Protsessy v Dosimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The possibility of the use of the thermo- and chemiluminescence of some luminophors for the dosimetry of ionizing radiation was investigated. The dependence of the intensity of the thermoluminescence of the ruby (1 to 10^6 r) and chemiluminescent yield of sodium zinc germanate (D phase) (10 to 10^9 r) on the γ radiation dose is reported. (tr-auth)

18457 USE OF FERROELECTRIC CRYSTALS AS DETECTORS OF GAMMA RADIATION. Panchenkov, G. M.; Kaushanskii, D. A.; Pluzhnikov, V. M.; Glazunov, B. P.; Avrorov, A. A.; Ositov, M. A. pp 140-143 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The use of polarized ferroelectric crystals (barium titanate) for the detection of γ rays is proposed. The current induced in the circuit containing ferroelectric crystals is proportional to the dose rate. The temperature dependence of the induced current was investigated and explained. It was shown that barium titanate can be properly used as a dose rate detector in the temperature range from 5 to 30°C. (tr-auth)

18458 RADIATION CONVERSION IN POLYCRYSTALLINE FILM LUMINOPHORS. Sizykh, A. G.; Spektor, L. I.; Malkes, I. Ya. pp 143-147 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Diaryl-derived ethylene and divinylbenzene used for dosimetry were investigated by uv and infrared spectroscopy. It was shown that the infrared and uv absorption spectra are correlated with the luminescent dosimetric parameters. The dependence of the radiolysis on the structure of the film and its thickness was established. The use of films with thickness greater than 5 μ was recommended for dosimetric use in the dose interval from 10^6 to 10^9 rad. (tr-auth)

18459 THEORY OF THE "OVERTAKING" EFFECT. Briskman, B. A.; Bondarev, V. D. pp 157-162 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

If an absorber–casing system, consisting of different materials, is placed in a radiation field then by suitable selection of these materials a situation arises in which the temperature of the casing during the course of time increases the temperature of the absorber. This difference in the heating rate is designated the "overtaking" effect. A method is proposed for the calculation of the overtaking time used during the construction of calorimeters. Processing of the results of the analytical and machine calculations made it possible to derive criterial empirical formulas ensuring errors not exceeding 5 to 10%. (tr-auth)

18460 USE OF LIQUID AND SOLID CHEMICAL DETECTORS IN NUCLEAR REACTORS. Bologova, G. S.; Briskman, B. A.; Tkachenko, V. V.; Trusova, V. P. pp 162-167 of Dozimetriya i Radiatsionnye Protsessy v Dosimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The possibility of individual measurement of the neutron and γ radiation dose of reactors with liquid (oxalic acid or glucose based) and solid (phosphate glass based) chemical methods was shown. The phosphate glass, activated with Mn, is almost insensitive to neutrons but liquid chemical detectors can be used to determine the size of the radiation chemical yields for γ radiation (G_γ) and neutrons (G_n). A calculation was made of the individual doses during reactor irradiation in water (D_γ and D_n). The values of D_γ and D_n obtained for water can be converted for other hydrogen-containing materials by the known mass absorption coefficient of γ irradiation and the weight fraction of water. (tr-auth)

18461 NEW ASPECTS OF USE OF GLUCOSE DOSIMETERS. Kovaleva, E. P.; Petryaev, E. P.; Kalyazin, E. P. pp 167-170 of Dozimetriya i Radiatsionnye Protsessy v Dosimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The use of glucose dosimeters was proposed for the determination of the total absorbed dose from reactor radiation in a wide dose range (0.25 to 1000 Mrad) with registration of the radiation effects from the gaseous radiolysis products, measured by gas chromatography methods. (tr-auth)

18462 COMMERCIAL DOSIMETRY OF MIXED REACTOR RADIATION WITH RADIATION CHEMICAL PROCESSES. Petryaev, E. P.; Kalyazin, E. P.; Kovaleva, E. P. pp 170-173 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The effect of the dose rate and LET during irradiation in reactor channels using deaerated ferrosulfate solutions and bichromate solutions was determined. The dependence of the yield of ethylene glycol on the concentration of methanol, the presence of oxygen, temperature, dose, and flow rate during irradiation of methanol solutions was investigated. The use of water-methanol solutions was recommended for the determination of the dose rate in the interval from 10^2 to 10^5 rad/sec and doses from 0.5 to 10 Mrad at temperatures up to 300°C. (tr-auth)

18463 INVESTIGATION OF DOSIMETRIC PROPERTIES OF TINTED POLYMERS. Kovalenko, L. M.; Gaichenko, I. N.; Lavrentovich, Ya. I. pp 174-178 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The effect of LET, dose rate, and temperature on the response of 15 types of chemical dosimeters of polyethylene terephthalate, regenerated cellulose, poly(vinyl chloride), polystyrene, poly-

(methyl methacrylate), and cellulose diacetate, tinted in different light with organic dyes, was investigated. The dependence of the response of dosimeters of polyethylene terephthalate, poly-(methyl methacrylate), and polystyrene and the very sharp dependence of regenerated cellulose dosimeters on the LET size was detected. The effect of a change of the LET size on the response of dosimeters of poly(vinyl chloride) and cellulose diacetate was not observed. Almost all the dosimeters are insensitive to a change of the dose rate and the effect of scattered light before and after irradiation. The absorbed dose can be determined with these dosimeters in the interval from 0.1 to 200 Mrad with a precision of ±5 to 10%. Simple formulas for the calculation of the dose are derived. (tr-auth)

18464 DOSIMETRY OF MIXED GAMMA–NEUTRON FIELDS WITH POLYMERS. Lavrentovich, Ya. I.; Kovalenko, L. M.; Staren'kii, A. G.; Velikovskii, A. A.; Kabakchi, A. M. pp 178-181 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Poly(methyl methacrylate), polyisobutylene, cellulose diacetate, and polyethylene were investigated under the effect of ^{60}Co γ rays, deuterons (14 MeV), and α particles. The effect of the LET size on the processes of destruction and cross linking of these polymers was shown. The LET size was varied from 0.2 to 30 keV/μ. The radiation yields of the cross linking and destruction processes of the polymers were calculated for the different forms of radiation. As a result of the studies made it was concluded that poly-(methyl methacrylate) and polyisobutylene are practically useless for the dosimetry of mixed fields with unknown energy spectra of the particles. For the determination of the total γ-neutron dose and of the contribution of the individual components to the dose the use of dosimeters of cellulose diacetate, polyethylene, and polytrifluorochloroethylene was proposed. Doses in the range from 5 to 50 Mrad can be determined with these dosimeters with an error of ±10%. (tr-auth)

18465 USE OF THERMOLUMINESCENT DETECTOR IKS IN GAMMA–NEUTRON FIELDS. Bochvar, I. A.; Viktorov, D. V.; Tkachenko, V. V.; Trofimov, V. M. pp 182-185 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The sensitivity of the IKS thermoluminescent detector to neutrons and γ radiation was investigated. It was shown that the sensitivity of the detector to neutrons with respect to the sensitivity of the detector to γ radiation at the identical absorbed dose in hydrogen-containing substances is no more than 5% for neutrons with an energy up to 5 MeV. The IKS detectors can be used for the registration of γ radiation doses during investigations in γ-neutron fields with minimum knowledge of the neutron spectrum. (tr-auth)

18466 USE OF STANDARD FERROSULFATE SYSTEMS IN DOSIMETRY OF REACTOR RADIATION. Ryabukhin, Yu. S. pp 185-188 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Calculations were made of the effective radiation chemical yields of ferrosulfate systems by numerical integration of the local yields according to the mean free paths. The curve of the radiation chemical yields according to the mean free path of protons as a function of the original energy of the protons agrees with the available literature data. The values of the effective radiation chemical yield showed 6.4 and 6.9 ions/100 eV for the absorbed energy of neutrons in water in the P-2 and B-3 channels. The energies, corresponding to the half contribution to the dose, were 350 keV for the P-2 channel and 670 keV for the B-3 channel. (tr-auth)

18467 USE OF SCINTILLATION SPECTROMETER WITH STILBENE CRYSTAL FOR DOSIMETRY OF MIXED GAMMA–NEUTRON RADIATION. Kovalev, V. P.; Kapchigashev, S. P.; Pavlov, L. P. pp 188-192 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The possibility of using scintillation spectrometer with a stilbene crystal for the dosimetry of neutrons and γ radiation in mixed fields was investigated. Calculations were made of the conversion factor Q(E) from the dose value in the detector materials to the absorbed dose value in standard tissues. It was shown that for a wide range of energy of the γ quanta and neutrons the size of Q(E) is practically constant for stilbene. The absolute doses and the relation of the dose for neutrons and γ quanta from Pu–Be sources with and without 5-cm thick lead shields were also investigated. The possibility of using this scintillation dosimetry method for the individual determination of the dose of intense neutron and γ beams, generated in electron linear accelerators, is discussed. (tr-auth)

18468 POSSIBILITY OF USING QUASI-ADIABATIC CALORIMETERS SHIELDED FROM SAMPLE TO BE TESTED FOR MEASUREMENT OF ENERGY RELEASE IN RESEARCH REACTORS. Vasil'ev, G. Ya.; Garusov, E. A.; Konoplev, K. A.; Sokolov, V. M. pp 192-197 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

An analysis was made of the heat loss and accuracy of the measurement of the specific energy release by quasiadiabatic calorimeters shielded from the sample to be tested. The use of the shielding made it possible to reduce the measurement errors resulting from heat loss from 10 to 20% to 0.5 to 2%. The construction of the quasiadiabatic calorimeter is described. The results of the measurement of the specific energy release in Al, steel, Cu, Pb, and graphite irradiated in the active zone and in the experimental channels of the VVR-M reactor are reported. This quasiadiabatic calorimeter makes it possible to measure the specific energy release in the range from 0.01 to 4 W/g with an accuracy of 4%. (tr-auth)

18469 SENSITIVITY AND MEASUREMENT LIMITS OF INDUCED RADIATION OF BIOLOGICAL SAMPLES DURING EXPOSURE DOSIMETRY OF INTENSE GAMMA–NEUTRON BEAMS. Karnaukh, I. M. pp 223-231 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

An evaluation is given of the sensitivity of the registration of the weak emission of biological samples used for tissue γ-neutron dosimetry and the dosimetry of x radiation. The emission intensity N is related to the irradiation dose D by the relation $D = k\Psi N$, where k is the dose constant of the emission of the given sample in imp/min.rad, and Ψ is the counting efficiency of the detector with respect to the standard in %. The laboratory installation and the portable instrument for the early classification of the biological samples according to the degree of radiation damage are described. (tr-auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 18051, 18136, 19028, and 19029.

18470 (AAEC/E-297) SEMICONDUCTOR X-RAY SPECTROMETER SYSTEM TYPE 454. Beech, A. McG.; Eberhardt, J. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

The Type 454 semiconductor detector x-ray spectrometer provides a resolution of 220 eV FWHM for the Fe K_α x-ray line at count rates up to 10^4 pulses per second, and is suitable for the energy range 4 to 60 keV. The preamplifier uses the pulsed optical feedback technique and a remounted input field effect transistor which operates at 130 K. The detectors are fabricated from commercially available hyper-pure n-type silicon and do not suffer from the carrier trapping effects exhibited by some lithium drift compensated silicon detectors at temperatures approaching 77 K. The high initial cost of this material is offset by savings in manufacturing time and in the cost of the sophisticated equipment required for lithium drift compensation of p-type silicon. (auth)

18471 (CEA-R-4551) SIMPLE METHOD OF COMPUTER PROCESSING OF DIODE γ SPECTRA. Remy, J.; Daburon, M. L.; Hanout, R.; de Beauvivier, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Feb 1974. 16p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Punched tape results of diode spectrometry are wholly processed by computer. The processing is near in principle to the so-called "manual" methods of peak investigation on cathodic screen or printed tape. The peaks detected are analyzed and their main characteristics printed out as tables. (auth)

18472 (EGG-1183-1526) AERIAL RADIOLOGICAL MEASURING SYSTEM (ARMS): SYSTEMS AND PROCEDURES EMPLOYED THROUGH FY71. Technical Report No. L-1038. (EG and G, Inc., Las Vegas, Nev. (USA)). 16 Aug 1973. Contract AT(29-1)-1183. 82p. Dep. NTIS $6.25.

The Aerial Radiological Measuring System (ARMS) designed and operated by EG&G, Inc., for the Division of Biological and Environmental Research and the Division of Reactor Development,

U. S. Atomic Energy Commission is described. Designed to rapidly survey large terrestrial surface areas for low-level background radiation, the ARMS has also proven extremely useful in locating lost radioactive sources of relatively low activity. The system consists of sodium iodide scintillation detectors, data processing electronics, Doppler radar positioning equipment, meteorological instruments, recording equipment, and direct readout hardware. The instrumentation, operational procedures, and data reduction techniques are described, together with their applications and sample results. (auth)

18473 (JAERI-1227) METHOD OF THE GAMMA-RAY SPECTRUM ANALYSIS. FORTRAN IV Programs "BOB 73" for Ge(Li) Detectors and "NAISAP" for NaI(Tl) Detectors. Baba, H.; Sekine, T.; Baba, S.; Okashita, H. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 66p. NTIS (U. S. Sales Only).

The problem of γ-ray spectrum analysis is treated by combining the peak-searching and peak-fitting processes. The stage of the peak recognition was built up by the first derivative method supplemented with various peak shape tests so that sufficient information is able to be supplied for the succeeding fitting step, rather independently of the types of the spectrum. By virtue of this constructed function of the peak search and the success of the analytical representation of the response function, the low-resolution spectrum from NaI(Tl) detectors was successfully analyzed based on the photopeak method as in the case of Ge(Li) detectors. As a result of various tests, the background shape under the peak was found no less important than the peak shape for the consistent fitting result, even in the case of the Ge(Li) spectrum. The core of either program, BOB73 or NAISAP, consists of the peak-searching and the peak-fitting functions and is accompanied by various subprograms such as the data pretreatment, energy calibration and efficiency correction, and plotting of the spectrum. The parameter finding for the response function is also an important function in NAISAP. The time required for the spectrum analysis depends on the complexity of the spectrum rather than the data size or the total number of peaks involved in the case of BOB73. A single spectrum with medium complexity is analyzed within the order of ten seconds. NAISAP requires about one second for analyzing one peak. The codes are described in some detail and the instruction manuals are described for the user's convenience. (auth)

18474 (SZS-149, pp 1-16) THREE-CHANNEL SPECTROMETER FOR MONITORING RADON DECAY PRODUCTS. Stepanek, E. Mar 1973. (In German).

For radioactivity measurements in working areas, especially in underground mines, a monitor was designed which allows the separate determination of the radon decay products RaA and RaC′ by alpha measurements. The air to be monitored is pumped through a filter, and the activity deposited on it is measured with a semiconductor detector. For separate measurements of RaA, RaC′, and the sum of both, the monitor contains three independent channels with corresponding memories. The four-figure result is indicated by numerical display tubes. (auth)

18475 CRITERIA FOR THE PROGRAMMING AND THE MONITOR SYSTEM IN SMALL PROCESS COMPUTERS. De Agostino, E.; Monaci, P. (CNEN, Rome). Automaz. Strum.; 20: No. 11, 584-589(Nov 1972). (In Italian). (RT/EL-(73)2).

General criteria conforming to the programming of a small process computer and to the organization of the monitor system are described. An example of operation and the conversational mode used with a neutron spectrometer is given. (auth)

18476 FACILITY AT THE NATIONAL NUCLEAR RESEARCH CENTER, PELINDABA, FOR THE CALIBRATION OF GAMMA SURVEY METERS USED IN URANIUM PROSPECTING OPERATIONS. Toens, P. D. (Atomic Energy Board, Pretoria); Van As, D.; Vleggaar, C. M. J. S. Afr. Inst. Mining Met.; 73: No. 12, 428-429(Jul 1973).

Ground radiometric surveys in uranium prospecting have in the past suffered from two serious shortcomings. Owing to varying instrument sensitivity and the often arbitrary height at which readings are taken, it has been impossible to compare results obtained in different surveys and, moreover, to relate such readings to actual U_3O_8 concentrations. A set of calibration sources designed to overcome these problems has recently been constructed on the site of the National Nuclear Research Centre, Pelindaba. A discussion of the standards applied and the instrument calibration procedure is presented. (INIS)

18477 STABILIZATION OF A BORE HOLE GAMMA SPECTROMETER BY MEANS OF AN INJECTION DIODE. Bakhterev, V. V.; Bausov, A. V.; Zyryanov, L. A.; Sen'ko-Bulatnyi, I. N.; Svetlov, M. I. (Physics Inst., Sverdlovsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1027-1028(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 41-42(1973).

A circuit for reference stabilization of a γ spectrometer is described. Light flashes of calibrated amplitude are generated by AL-102A and US-2 injection diodes made of GaF. The stability of the spectrometer is ±0.25%. The spectrometers are suitable for nuclear-geophysics research. (auth)

18478 Gi(Li) DETECTOR WITH SEPARATE SENSING REGIONS AND CERTAIN OF ITS APPLICATIONS IN NEUTRON ACTIVATION ANALYSIS. Akinshin, B. K.; Margolin, E. M.; Pakhomov, E. E.; Pakhomova, A. L.; Polytaya, O. P.; Sot-skov, Yu. P. (Inst. of Mineralogy, Geochemistry, and Crystallochemistry of Rare Elements, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1066-1070(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 71-75(1973).

A duode spectrometer is described which allows the Compton background to be suppressed by a factor of 4 to 5 in the energy range from 0.3 to 1.5 MeV. The technique of internal summation is used, and the feasibility of its application is investigated. In using a duode spectrometer to determine the scandium content in magnetite samples a threshold sensitivity of 7×10^{-6}% was obtained. (auth)

18479 MEASUREMENT OF THE PHOTOFISSION CROSS SECTIONS OF NUCLEI USING AN ELECTRONIC COMPUTER ON THE EXPERIMENTAL LINE. Gurevich, G. M.; Zapevalov, V. A.; Lazareva, L. E.; Solodukhov, G. V.; Yavorovskii, V. I. (Inst. of Nuclear Research, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1020-1023(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 35-38(1973).

A system for automated measurement of the total cross section of γ-quantum absorption by nuclei using the Ural-11B electronic computer operating on the experimental line is described. The system records data on magnetic tape, corrects them for the drift of the parameters of the recording equipment, performs further mathematical handling, and also controls the operation of external devices. (auth)

18480 MEASUREMENT OF THE SPECTRA OF FISSION FRAGMENTS AGAINST THE BACKGROUND OF LARGE ALPHA PARTICLE FLUXES. Kuks, I. M.; Selitskii, Yu. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1063-1065(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 69-71(1973).

A simple electronic circuit is described that is designed for the spectrometry of fission fragments by means of a semiconductor detector. The circuit performs amplification, selection, and stretching of pulses from fragments and allows their amplitude to be measured for an alpha-particle flux intensity to the detector equal to 10^6 sec^{-1} and a fragment intensity that is 10^3 to 10^5 times smaller. Data are presented on the radiation immunity of p-n detectors made of low-ohm Si in fluxes of α-particles and neutrons. (auth)

18481 ISOLATING THE NULL DRIFT OF THE MOTION SIGNAL IN A NUCLEAR GAMMA RESONANCE SPECTROMETER. Semenkin, V. A.; Vainshtein, V. M. (Ural Polytechnic Inst., Sverdlovsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1042-1044(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 52-54(1973).

A circuit is proposed for isolating the drift of the null level of the signal that stipulates the motion of the source in a nuclear gamma resonance spectrometer having constant acceleration. The circuit does not use source-division pickups. The drift is isolated by means of a sensing discriminator based on a tunnel diode. The high sensitivity is determined by the nonlinear commutated load of the diode. (auth)

18482 RECENT DEVELOPMENTS IN SUBNANOSECOND TIMING WITH COAXIAL Ge(Li) DETECTORS. White, D. C.; McDonald, W. J. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 115: No. 1, 1-11(1974).

A pulse-shape discrimination technique has been developed using a dual constant-fraction discriminator combination to analyze γ-ray pulses from a Ge(Li) coaxial detector, in order to obtain improved time resolution for this type of detector. A theoretical analysis of the pulse shapes from a coaxial detector as a function of the position of irradiation in the detector, and the synthesis of these pulses in a Constant-Fraction Pulse-Height Discriminator has been completed to form a theoretical base to the technique. Typical results for coincidence measurements with a 23 cm^3 coaxial detector and a plastic scintillator are: 1.09 ns fwhm and 2.02 ns fw(0.1)m for a γ-ray energy range of $1.10 \leq E \leq 1.35$ MeV and 650 ps fwhm for a 3.16 MeV γ-ray. (auth)

18483 FULL-ENERGY PEAK EFFICIENCY OF CADMIUM-TELLURIDE GAMMA-RAY SPECTROMETERS. Siffert, P. (CEN,

Strasbourg); Gonidec, J. P.; Cornet, A.; Bell, R. O.; Wald, F. V. Nucl. Instrum. Methods; 115: No. 1, 13-21(1974).

Taking into account the different interaction mechanisms of γ-rays with matter, we have calculated the pulse-height distribution resulting from the bombardment of cadmium-telluride (CdTe) counters by ^{137}Cs and compared the results to the experimental distributions. Comparisons with equivalent sensitive volume Si(Li) and pure Ge counters have also been made. The dependence of the full-energy peak efficiency as a function of applied bias voltage, position of the inter ction, time relative to the application of bias, and energy of the incident radiation has also been investigated. (auth)

18484 DETERMINATION OF LIFETIMES WITH A DIGITAL CORRELATOR IN REAL TIME. Daniere, J. (Univ. Claude Bernard, Lyon); Rougny, R.; Descroix, E.; Charnay, D.; Billerey, R.; Chevalier, H. Nucl. Instrum. Methods; 115: No. 1, 165-171 (1974). (In French).

A digital correlator giving the autocorrelation or the intercorrelation function of two signals X(t) and Y(t) in true time is used. The incremental delay is adjustable between 100 ns and 1 s, by 100-ns steps. The application of this correlator to nuclear spectroscopy was studied and compared to other methods used for nuclear lifetimes determination. (auth)

18485 CORRECTION OF EXPERIMENTAL RESULTS IN FISSION EXPERIMENTS. II. Neutron Yield Corrections. Gavron, A. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Instrum. Methods; 115: No. 1, 99-104(1974).

Various corrections have to be performed when the time-of-flight method is used, to determine the average number of neutrons emitted by fission fragments. These corrections enable one to determine the average number of neutrons in fission as a function of the fragment mass and total kinetic energy within the statistical errors, in most of the mass range. (auth)

18486 CORRECTION OF EXPERIMENTAL RESULTS IN FISSION EXPERIMENTS. I. Dispersion Corrections. Gavron, A. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Instrum. Methods; 115: No. 1, 93-98(1974).

The effect of mass and kinetic-energy dispersion on the results of fission experiments has been investigated. The effect is found to be small, except for the mass region close to symmetric fission. (auth)

High Energy Physics Instrumentation

Refer also to abstract 18543.

18487 (INS-TH-83) MULTISCAN DIGITAL VOLTAGE MONITOR. Shiino, K.; Imanishi, A.; Mishina, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 15 Mar 1973. 24p. (In Japanese). NTIS (U. S. Sales Only).

A multi-input scanning voltage monitor was devised aiming at the long term continuous monitoring of NIM standard power supplies for the electronic circuits used in the high energy experiment at the INS synchrotron. The system samples each of the DC voltages from ten power supplies cyclically. The voltage is measured by a digital voltmeter on the front panel and the measured value is compared digitally with the upper and the lower limits preset by a pair of digital switches. When the measured voltage is within the allowance, the scanning is continued. Once an abnormal voltage is detected, the scanning and the indication of the digital voltmeter is halted and an alarm begins to buzz. In another mode, one can use this system to calibrate any one voltage input with the scanner stopped. The sampling rate is about 4 sec per one point so that the same point is scanned every seven minutes. The present monitor is already being used in the experiment and working satisfactorily. (JA)

18488 (JINR-E1-7567) GEOMETRICAL EFFICIENCY FOR THE TRIGGERED HIGH PRESSURE STREAMER CHAMBER OF THE JINR. Albu, M.; Besliu, T.; Falomkin, I. V.; Georgescu, C.; Mihul, A.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Using various methods, the geometric efficiency for the triggered high-pressure streamer chamber of the JINR is calculated. (auth)

18489 DIGITAL DECISION DEVICE FOR USE IN HIGH ENERGY PHYSICS EXPERIMENTS. Derevshchikov, A. A.; Guzik, Z.; Matulenko, Yu. A.; Nurushev, S. B.; Smirnov, E. V.; Solov'yanov, V. L. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1088-1090 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 90-92(1973).

A digital decision device is described which has been developed for investigating the elastic scattering of particles at small angles. During a time $\tau = 800$ nsec the device calculates the angle corresponding to the given event, compares it to the boundary angle set on a tumbler register, and produces a signal at the output if the scattering angle exceeds the boundary value. The use of this device allows the rate of acquiring statistics to be accelerated by a factor of 16 in the experiment on elastic scattering of π^--mesons by protons at a momentum of 40 GeV/c. (auth)

18490 TIME-OF-FLIGHT METHOD IN EXPERIMENTS WITH COLLIDING BEAMS. Fel'dman, L. G.; Fominykh, V. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1018-1019(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 33-34(1973).

In order to eliminate the cosmic-particle background, the VEPP-3 installation with colliding electron-position beams uses the time-of-flight method. Eight scintillation counters having the dimensions 1200 × 250 × 10 mm are arranged symmetrically around the beams. The time resolution of the system of counters is equal to 0.6 nsec. (auth)

18491 HIGH SPEED DECODER FOR CONVERTING CHANNEL NUMBERS FROM A DECIMAL CODE TO A BINARY CODE. Smirnov, V. V.; Simonov, Yu. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1099-1101(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 99-101(1973).

The circuit of a matrix decoder with a number of inputs ranging from 7 to 15 is described which is designed for use in systems of coordinate pickups (scintillation hodoscopes, spark, and proportional chambers, etc.) in accelerator experiments. The maximum speed of response of the circuit is 30 MHz. (auth)

18492 ISOLATION OF A CHERENKOV FLASH IN A CsI(Tl) SCINTILLATION CRYSTAL. Kudryavtsev, M. I.; Melioranskii, A. S.; Savenko, I. A.; Shamolin, V. M. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1083-1085(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 85-87(1973).

A CsI(Tl) crystal is used as a scintillator and a Cherenkov-radiation radiator ($n = 1.8$). The Cherenkov component of the light flash can be used in order to convert the scintillation counter into an instrument that allows particles traveling in a stipulated direction to be isolated. (auth)

18493 EXTRACTION OF INFORMATION FROM WIRE SPARK CHAMBERS WITH MEMORY BASED ON FERRITE RINGS. Karpekov, Yu. D.; Makarov, G. P.; Sergeev, V. A.; Simonov, Yu. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1047-1049(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 56-58(1973).

A system is described for extracting information from wire spark chambers containing up to 63,000 wires with a memory based on ferrite rings. When desired it is possible to interrogate all the groups of rings successively, or only those groups of rings which carry information on the addresses of the sparks. (auth)

18494 RECORDING THE MAGNETIC FIELD ON A PHOTOGRAPHIC FILM DURING PHOTOGRAPHY OF EVENTS IN TRACK CHAMBERS. Skachkov, S. V.; Simonov, B. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1050-1052(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 59-61(1973).

The field variations caused by the instability of the power supply and certain other causes are picked up by a measurement winding, integrated, and cause deflection of a microammeter in an installation with a streamer chamber that is situated in the gap of the electromagnet. The meter is photographed on the same frame as the event in the chamber. The installation requires periodic correction of the integrator zero. The problem of the accuracy with which the field is measured along a particle track is discussed. An accuracy $\Delta B/B \simeq 3 \cdot 10^{-4}$ is achieved. (auth)

18495 MEASUREMENT OF THE RELATIVE ENERGY OF GAMMA QUANTA IN THE 1 TO 40 GeV RANGE BY MEANS OF A SPARK SPECTROMETER. Bolotov, V. N.; Devishev, M. I.; Devisheva, M. N.; Isakov, V. V. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1024-1026(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 38-40(1973).

The possibility is demonstrated of measuring the relative energy of γ quanta from the decays of π^0 mesons having momenta of up to several tens of GeV/c. The energy was determined according to the blackening density of the images of electron-photon lines from a spark spectrometer on photographic film. The standard deviation was 15% for γ quanta having energies of 10 to 40 GeV. (auth)

18496 PROPORTIONAL CHAMBERS FOR A 50,000-WIRE DETECTOR. Bouclier, R.; Charpak, G.; Chesi, E.; Dumps, L.; Fischer, H. G.; Hilke, H. J.; Innocenti, P. G.; Maurin, G.; Minten, A.; Naumann, L.; Pluz, F.; Santiard, J. C.; Ullaland, O. (CERN, Geneva). Nucl. Instrum. Methods; 115: No. 1, 235-244(1974).

A multiparticle spectrometer at the CERN Intersecting Storage Rings is equipped with proportional chambers. The construction of 20 modular 100 × 200 cm^2 wire chambers, the electronics for a 50k wire system, and the performance of the chambers are described. (auth)

18497 COSMIC RAY TELESCOPE USED TO SEARCH FOR MASSIVE AND/OR FRACTIONALLY CHARGED PARTICLES. Alcock, C. R.; Chisholm, A.; Tyndel, M.; Yock, P. C. M. (Univ. of Auckland, New Zealand). Nucl. Instrum. Methods; 115: No. 1, 245-252(1974).

A telescope used to search for massive and/or fractionally charged particles in the cosmic radiation is described. The telescope uses plastic scintillators (for ionization and time-of-flight measurements), wide gap spark chambers (to fix particle trajectories) and lead/iron absorbers (for range measurements). Timing and ionization measurements are recorded using a fast oscilloscope. Measurements are recorded for slow particles ($0.2\,c < v < 0.55\,c$) only. The accuracies of the measurements are such that charge measurements deduced from the speed and ionization measurements are accurate to 0.05 e (one s.d.). The construction, calibration, and operation of the telescope are described. (auth)

18498 CHARACTERISTICS OF CESIUM IODIDE FOR USE AS A PARTICLE DISCRIMINATOR FOR HIGH-ENERGY COSMIC RAYS. Crannell, C. J. (Federal City Coll., Washington, DC); Kurz, R. J.; Viehmann, W. Nucl. Instrum. Methods; 115: No. 1, 253-261(1974).

The possible use of CsI to discriminate between high-energy cosmic-ray electrons and interacting protons has been investigated. The pulse-shape properties as a function of ionization density, temperature, and spectral response are presented for thallium-activated CsI and as a function of ionization density for sodium-activated CsI. The results are based on previously published data and on corroborative measurements from the present work. Experimental results on the response of CsI to electron-induced electromagnetic cascades and to interacting hadrons are described. Bibliographies of publications dealing with the properties of CsI and with pulse-shape discrimination techniques are presented. (auth)

18499 EFFICIENT IDENTIFICATION OF RELATIVISTIC PARTICLES BY TRANSITION RADIATION. Cherry, M. L.; Mueller, D.; Prince, T. A. (Univ. of Chicago). Nucl. Instrum. Methods; 115: No. 1, 141-150(1974).

A system of transition-radiation detectors has been constructed and exposed to beams of electrons and pions in the energy range 3 to 15 GeV at SLAC. Transition radiation was generated in a variety of stacks of mylar foils (radiators), and background tests have been performed with solid targets replacing the radiators. The radiation intensity was detected with 7 multiwire proportional chambers and with high-Z scintillators [Ba(Pb)SO_4, $CaWO_4$]. To obtain a high x-ray conversion efficiency, the proportional chambers had a thickness of 4.5 cm and were filled with xenon–CO_2 or krypton–CO_2 mixtures. The transition-radiation yield has been measured, and its dependence on the particle energy and on the radiator configuration has been investigated. While the raw data demonstrate a good separation between electron- and pion-induced signals, a more detailed analysis of the data has been performed and is discussed. The results of this analysis show that a very efficient identification of individual particles is possible. Typically, a detection efficiency for electrons above 90%, combined with a pion–electron discrimination ratio of 10^{-3}, has been achieved. Some conclusions with respect to the design of a practical detector for relativistic particles is drawn. (auth)

18500 RESOLUTION IN A NEON–HELIUM STREAMER CHAMBER. Lightfoot, J. A.; Breare, J. M. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 115: No. 1, 121-123(1974).

The most probable length of streamers which form along the track of an ionizing particle in a streamer chamber is shown to vary with the pulse delay in a way which can be predicted by theory. The precision of length measurements are such that the arrival time of particles in the chamber may be resolved to better than 5 μs in the range 0 to 20 μs. Measurements of these lengths have also been used to determine the streamer extension velocity which, for a streamer 0.74 cm long, is found to be $(3.2 \pm 0.7) \times 10^9$ cm/s. (auth)

18501 GRAY CODE HODOSCOPE AND FAST BUFFER FOR BEAM PARTICLE TAGGING. Pellett, D. E.; Erwin, J.; Faulkner, D.; Ko, W.; Lander, R. L.; Yager, P. M. (Univ. of California, Davis). Nucl. Instrum. Methods; 115: No. 1, 135-139(1974).

A scintillation counter hodoscope to measure the vertical position of a high energy charged particle with associated identity information is described. It may be used to tag beam tracks seen in detectors with poorer time resolution, such as bubble or spark chambers. The hodoscope consists of six overlapping planes of plastic scintillator strips $\frac{1}{8}$ in. thick, 3 in. wide, and varying height and vertical spacing. The vertical resolution is $\frac{3}{32}$ in. over a 6 in. height. Each plane is connected to a single photomultiplier tube. The output from the six tubes forms the Gray code of the vertical position of a track passing perpendicularly through the planes. This and three bits of tagging information form a nine bit word associated with each track. Up to 16 such words are stored in an ECL buffer capable of accepting a new track every 20 ns. The buffer is interfaced to a DGC Supernova computer through CAMAC. The construction and performance of the device are discussed. (auth)

18502 STORAGE OF PARTICLE TRACKS IN A STREAMER SPARK CHAMBER. Eckardt, V. Hamburg; Univ. Hamburg (1972). 61p. (In German).

Thesis.

Tracks of elementary particles can be stored in a streamer spark chamber by using two consecutive high-voltage pulses. In this process, metastable atoms are serving as information carriers which are formed in the avalanche of the first high-voltage pulse and continue for quite a time to produce free electrons in the gas via collisions of the second kind (Penning effect). These free electrons are made visible by the second high-voltage pulse. For a memory time of less than one microsecond, a storage time of some milliseconds is possible. The measuring accuracy during storage operation is essentially determined by the diffusion of the metastable atoms and the free electrons. The diffusion of the latter is strongly reduced in a magnetic field perpendicular to the field direction. The diffusion constant in a neon–helium mixture has been determined under normal operating conditions in the 1 m-streamer spark chamber of DESY as a function of the magnetic field strength. It was found to be reduced from 640 cm^2/s without magnetic field to 20 cm^2/s at 1.9 Tesla. The spatial resolution remains practically the same. In order to measure and control the memory time, a new method has been developed which is based on the inequality of masses of electrons and negative SF_6 ions, added to reduce the memory time. This results in a measuring and controlling accuracy of ±2% for a memory time of two microseconds. (GE)

18503 READOUT SYSTEM FOR MULTI-WIRE PROPORTIONAL CHAMBERS. Haggerty, H.; Handler, R.; Smith, G.; Wilke, W. (Univ. of Wisconsin, Madison). Nucl. Instrum. Methods; 115: No. 1, 157-163(1974).

A serial readout system for a 2000-wire proportional chamber array is described. Addresses were processed through a Camac data system into an augmented PDP-8 computer. (auth)

18504 DOSIMETRY OF HETEROGENEOUS MEDIA. Lenchenko, V. M.; Antsilevich, M. G.; Sofienko, L. A.; Kishinevskaya, M. B.; Tsoi, A. N. pp 95-100 of Dozimetriya i Radiatsionnye Protsessy v Dosimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The results of experiments on the γ irradiation of dosimetric media with metallic radiators placed in it were reported. The possibility of using these results for the calculation of the spectrum of primary γ radiation was shown. (tr-auth)

Radiometric Instruments

18505 SEDIMENTOMETER. Allen, T. British Patent 1,327,044. 15 Aug 1973. Filed date 14 Jan 1970. 7p.

An x-ray sedimentometer is described for analyzing suspensions of particulate solids in a liquid, with a view to determining particle size distribution in powders. In previous equipment a continuous x-ray source requiring a high voltage high current supply, together with water cooling, has been used which, due to instability of output, necessitated the use of a reference system. In the system described an isotope source is used which, due to its excellent stability characteristics, eliminates the need for a reference system. The system comprises a sedimentation tank, an isotope x-ray source at one side of the tank, and a proportional counter positioned at the opposite side. The x-ray source and the counter are movable to enable measurements to be taken at different distances from the liquid surface in the tank. The output from the counter is fed to circuitry comprising a rate meter fitted with a zero suppression control, and to count integrated circuits for smoothing out statistical variations in the counter output. A motor is provided for moving the source and counter, together with a timing device for switching the motor on after a preset time and a microswitch for stopping the motor after it

has moved the source and counter a predetermined distance. A suitable x-ray source is $^{147}Pm/Al$. The tank may be of vertical type in which the suspension settles under gravity, or may be a disk centrifuge. (UK)

18506 INDUSTRIAL APPLICATIONS OF CONTACTLESS MEASUREMENT USING RADIOACTIVE SOURCES. Netz, V. (VEB Messelektronik, Dresden). Hutn. Visty; 28: No. 2, 135-137(Feb 1973). (In Czech).

A review is presented of equipment designed for the application of radioactive emitters in measurements and inspection in the industries of the German Democratic Republic. Specifically, thickness and density gages, level indicators, and analytical instruments are described. (INIS)

18507 APPLICATION OF RADIOMETRIC METHODS IN WEAVING MILLS AND IN SLUBBINGS. Trauter, J. Chemiefasern Text.-Anwendungstech./Text. Ind.; 23: No. 2, 112-117(1973). (In German).

From conference on application of radiometric measuring techniques in textiles; Duesseldorf, Germany (16 Nov 1972).

In slubbing, the finishing is particularly suitable for the use of radiometric measuring methods. One can thus determine the yarn loading continuously and with sufficient accuracy which is very significant if the weaving mills are to be profitable. The different measuring processes presented can be simplified. Even with a measuring probe, as in all cases the factors influencing the measurements being set, very good results are to be expected. Against this, the weaving mills offer little possibility of use. The results of the investigation carried out in the weaving mills and goods control promise no real worthwhile application even in controlling expensive tissues. (GE)

18508 CONTROL SYSTEMS IN TEXTILE FINISHING WITH SPECIAL REGARD TO RADIO METERING. Beckstein, H. Chemiefasern Text.-Anwendungstech./Text. Ind.; 23: No. 1, 36-41(1973). (In German).

From conference on application possibilities of radiometric measuring methods in textile industry; Duesseldorf, Germany (16 Nov 1972).

The most important control systems used in finishing processes, such as the straightening of drafted fabric, adjustment of the squeezing effect, optimum drying of wet fabric, measurement of fabric temperature for economic thermosetting, control of mesh density, and area weight are discussed. The radiometric measuring possibilities are discussed. (GE)

18509 CHARACTERISTICS OF A NEUTRON MOISTURE GAGE WITH A SOLID STATE DETECTOR. Nagpal, M. K. (Kurukshetra Univ., India); Mehta, P. P.; Nagpaul, K. K.; Rama. Pramana; 1: No. 2, 112-116(Aug 1973).

The development of a neutron moisture gauge, using ^{252}Cf as a source of fast neutrons and muscovite as a detector of thermal-neutron-induced-fission in ^{239}Pu target, is reported. The laboratory and the field calibrations of the instrument reveal a linear relation between track count rate and the moisture volume fraction. Low cost, low weight, simplicity of operation, thermal stability and elimination of electronic components and power supplies are the attractive features of this instrument. The main drawback is its poor detection efficiency for thermal neutrons and the consequent unsuitability as a routine logging instrument. Its special features make it particularly suited to deep borehole logging such as in oil exploration. (auth)

18510 CONVEYOR BELT WEIGHING USING NUCLEAR TECHNIQUES. Sigal, P. M. Aust. Process Eng.; 1: No. 5, 25-27(Jul 1973).

The application of a nuclear radiation technique to the weighing of materials on a conveyor belt is compared with mechanical means of weighing. Maintenance, installation, and calibration are described. The instrumentation of nuclear techniques is described and a description is given of how this may be applied on a plant where it is impractical to use a mechanical system. (AT)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 18827.

18511 (ORNL-4873) EFFECTS OF ELECTROMAGNETIC PULSE (EMP) ON STATE AND LOCAL RADIO COMMUNICATIONS. Final Report, October 1973. Barnes, P. R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 174p. Dep. NTIS $7.60.

The electromagnetic pulse (EMP) produced by a high-altitude nuclear detonation consists of a transient pulse of high intensity electromagnetic fields. These intense fields induce current and voltage transients in electrical conductors. If these transients are well coupled to electronic circuits, equipment malfunction or failure may result. In this study, analytical, numerical, and experimental techniques have been used to determine the effects of EMP on the two-way radio communication systems available for civil defense. The results of this study indicate that the probabilities of failure for two-way radio communication systems without EMP protection is a strong function of the radio carrier frequencies that compose the electromagnetic links of the systems. The probabilities of failure are also a relatively strong function of the EMP's amplitude and time history, the active electronics components employed in the communications equipment, gain and type of antennas in the system, the use of RF overload protection, and system configurations. The probability of communications failure for these systems can be reduced to near zero by implementing a recommended emergency preparedness program. This program consists of providing low-cost EMP protection for the systems and emergency backup equipment for some essential system components. (auth)

18512 (PEM-6) NUCLEAR EMP: EXPERIMENTAL RESULTS OF TESTING RESISTORS UNDER PULSE CONDITIONS. Lennox, C. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov. 1967. 25p. Dep. NTIS $3.25.

Limits of pulse voltage and power rating of ordinary resistor circuit components were studied. Wire-wound resistors stand pulse power of more than 5000 times dc ratings, metal film more than 1000, and carbon composition more than 500 times. The "stress-step" method of applying incrementally increased voltages and measuring resistance change until failure was used. Curves of maximum safe voltages are given. Types of failures: internal breakdown, arc across casing, and a catastrophic behavior are discussed. (auth)

18513 (PEM-7) NUCLEAR EMP: FAILURE THRESHOLD AND RESISTANCE OF THE PROTECTED AND UNPROTECTED 2N2222 TRANSISTOR IN THE SHORT PULSE WIDTH REGIME. Stadler, P. H. (Philips, 75, Paris (France); Harry Diamond Labs., Washington, D.C. (USA)). May 1972. 54p. Dep. NTIS $4.75.

The development of a pulser and test chamber for damage investigations in less than 100 ns pulse width regimes is described. The investigation of approximately 100 2N2222 transistors, and forward and reverse damage threshold levels for some 60 (B-E junction) are defined. An avalanche diode protection experiment wherein a 9 V zener diode was paralleled with the 7 V B-E junction showed promise, but with possibly a need for low capacitance diodes and back-to-back zeners. Suggested additional work includes physics of failure, models, validation of models, and other damage and experimental investigations. (auth)

18514 (PEM-9) NUCLEAR EMP: EMP PROTECTIVE SYSTEMS. Clark, D. B.; Johnston, J. A. (Frankford Arsenal, Philadelphia, Pa. (USA). Research and Development Directorate). [nd]. 63p. Dep. NTIS $5.25.

A description of representative problems and solutions corresponding to a representative electromagnetic pulse from a high-altitude burst is described. Anticipated functional and survival problems in telephone circuits, teletypewriter landlines, switching terminals and switchboards are discussed. Typical problems in Emergency Operating Centers (EOC's) concern antenna grounds, unshielded communications equipment of very wide variety, inadequate telephone frames grounds, power system grounds and transient protection, and generally unshielded sensitive control and monitoring equipment. A qualitative discussion of approach for EMP protection of EOC's, in particular the problem of differing impedances in ground circuits, and positive steps to insure better grounds for several specific cases is presented. Actual improvement factors are not stated. (auth)

18515 (PEM-14) NUCLEAR EMP: CABLE SHIELDING EFFECTIVENESS TESTING. Knowles, E. D.; Olson, L. W. (Boeing Co., Seattle, Wash. (USA)). 1970. 21p. Dep. NTIS $3.25.

An improved method of measuring shielding effectiveness of cables against EMP is presented. This method consists of a quadraxial cylindrical test fixture which contains a current probe around the test specimen that forms the center conductor of a terminated coaxial system within a signal tube and the outer guard line. Braid angle, optical coverage, wire size, braid material, and cable length were parameters of a braid sheath investigated. Summary data curves are included. Conclusions indicate a re-

peatable method of testing shielding effectiveness over wide ranges of frequencies up to 100 MHz and for long cable specimens. Some references up to year 1970 are included. (auth)

18516 (PEM-16) NUCLEAR EMP: MANUFACTURING TECHNIQUES IN PACKAGE INTERCONNECTION AND BONDING AND SHIELDING. Rodgers, J. H. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). [nd]. 10p. Dep. NTIS $3.00.

General discussion of real problems of implementing designs include cleanliness and freedom from contamination, positioning and securing of gaskets, maintaining mechanical electrical joints between layers of braid, developing repair procedures, and providing periodic training courses. Process control requirements on equipment and tools insure reliability of joints as do torquing operations and inspection. Five figures illustrating tools and techniques and eight typical process specifications used to control EMP attributes and maintain reliability are provided. (auth)

18517 (PEM-18) NUCLEAR EMP: CABLE DESIGN AND TEST PRACTICES. Burgoon, J. R. Jr. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). [nd]. 11p. Dep. NTIS $3.00.

The conceptual studies, trade-offs, and experiments are outlined which describe the evolution of an interconnect cable design. Susceptible devices are contained within shielding enclosures that, practically speaking, include a shielding material of necessary thickness, conductivity, and permeability, and which minimize slots, seams, and other such electrical shield discontinuities. Twenty design ground rules are given which are formulated in the language of practices that involve common terminology in electrical systems, e.g., (1) an exterior cable shield which completely encloses all wiring shall be used, (2) exterior cable shields shall be bonded to the periphery of the backshell of connectors with a continuous rf-tight conductive surface, (3) all shields, within or on the outside of a cable, must be insulated from each other and any metallic supporting structure except at bonding points, etc. Other information is provided on concept verification, in design control, and in service life evaluation. (auth)

18518 (PEM-19) NUCLEAR EMP: MANAGEMENT PLAN AND TECHNIQUES FOR EMP PROTECTION OF SYSTEMS. Peabody, P. B. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). [nd]. 6p. Dep. NTIS $3.00.

A general approach to EMP protection of anything from an electrical component to a complete system is provided along with certain major pitfalls and a general management approach to avoid them. Awareness precautions are included to insure or maintain EMP hardness after it originally has been achieved. (auth)

18519 (PEM-24) NUCLEAR EMP: SHORT PULSE WIDTH FAILURE LEVEL CHARACTERIZATION FOR THE 2N3821 JUNCTION FIELD EFFECT TRANSISTOR. Lunn, T. C. (McDonnell Douglas Astronautics Co., Santa Monica, Calif. (USA)). 1972. 60p. Dep. NTIS $5.00.

Subsystem electromagnetic pulses (EMP) susceptibility threshold is ultimately determined by the ability of electronic components to withstand relatively high level, short duration electrical stress. A recent EMP test on an autopilot revealed that a field effect transistor (commercial equivalent 2N3821) established the unit's susceptibility threshold. The results of an investigation performed to characterize the 2N3821 failure modes for stressing conditions from 20NS to 1000NS in duration are reported. Failure levels are given for both reverse and forward junction stressing. Forward stressing resulted in damaged metallization. Reverse stressing to failure required less energy than forward stressing. In the reverse stress mode, damage occurred to the device junction. The failure mode for reverse stress conditions appears to be that of thermal second breakdown, a process for which predictive techniques have been developed and are discussed herein. For very short pulse durations, non-uniform heating can result in large failure energy differences from device to device. The devices tested in this experiment displayed approximately one order of magnitude range in failure levels for pulse widths less than 50 nanoseconds. (auth)

18520 THERMOLUMINESCENCE OF LEAD SULPHATE DOPED WITH SAMARIUM. Beaven, H. J. (Devizes School, Eng.); Clark, W. C.; Ayliffe, S. H. J. Phys., D (London); 7: No. 1, L12-L16(1 Jan 1974).

The preparation of the thermoluminescent material $PbSO_4$ doped with 0.06 mol % Sm is described. Diffuse reflection spectra show that exposure to γ or uv radiation induces color centers with absorption maxima at 390 and 540 nm. They are bleached when the material is heated. The glow emission spectrum is typical of other samarium-doped sulphates. The glow curve has a large composite peak at 160°C which could be utilized for image storage or for radiation dosimetry. (auth)

18521 CONDUCTIVITY OF ELECTRIC-INSULATING MATERIALS IN INTENSE CURRENT OF REACTOR RADIATION. Aseev, N. A. pp 210-215 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

It was shown experimentally that the conductivity of insulating materials can significantly change because of the sharp increase of the conductivity of the gaseous medium (He) under intense irradiation. Under the conditions of a high-current reactor Mg and glass fibers are recommended as insulators. Organic insulating material can be used only up to the integral dose 5×10^{17} to 2×10^{18} for fast neutrons and at temperatures no higher than 200°C. (tr-auth)

18522 SOME FACTORS RESPONSIBLE FOR EFFICIENCY OF AN ELECTRICAL SIGNAL TRANSMITTER OPERATING IN REACTORS. Aseev, N. A.; Samsonov, B. V. pp 215-219 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The effect of insulation on the operation of different electrical signal transmitters was investigated under various irradiation conditions. The error in the operation of the transmitter because of the appearance of insulator conductivity, space charge, compensation current, and potentials of significant size was calculated. The selection of materials with a minimum content of activating isotopes was recommended for insulation of low-current transmitters. (tr-auth)

18523 EFFECT OF HIGH-INTENSITY REACTOR RADIATION ON THERMOCOUPLE RESPONSE. Markina, N. V.; Tsykanov, V. A. pp 219-223 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The results of the study of the operation of Chromel–Alumel and tungsten–rhenium thermocouples in an intense current of mixed reactor radiation (thermal neutron current of 4×10^{13} neutrons/cm^2, dose rate of 5×10^5 r/hr, and calibration by the solidification point of the pure metals) are reported. The errors which must be considered during temperature measurements in a reactor using thermocouples were determined. (tr-auth)

Miscellaneous Instruments

Refer also to abstracts 18255, 18860, 19267, 19662, 20064, and 20302.

18524 NOISE THERMOMETRY. Brixy, H. G. (Kernforschungsanlage Juelich, Ger.). Kerntechnik; 15: No. 10, 458-463 (Oct 1973). (In German and English).

In contrast to the thermometers which have been previously used (thermocouples, resistance thermometers, etc.), the noise thermometer is independent of all environmental influences, such as reactor radiation or atmosphere. It is independent of its thermal and mechanical pretreatment and of the material used. Consequently, the noise thermometer retains its initial accuracy even over any operating range. Noise thermometry is applicable between 0.1 and ~2500°K and gives the absolute temperature directly. (GE)

18525 APPARATUS FOR MEASURING PARTICLE SIZE. Rattray, H. D. (to United Kingdom Atomic Energy Authority). British Patent 1,334,876. 24 Oct 1973. Filed date 5 Oct 1971. 1p.

An apparatus is described that is intended primarily for the measuring of nuclear fuel particle sizes. It comprises a vertical glass guide tube to contain a column of particles stacked singly one above another, together with a transducer, alongside the tube, connected to a readout device the output of which can be recorded on punched tape or an electrical display device. The tube and transducer are located above a horizontal Vee groove in a measuring block, with a rod-like pusher for transferring a particle from beneath the tube to beneath the transducer. The pusher has an adjustable nominal stroke of 0.05 in. and is actuated by a synchronous motor through a cam mechanism. The pusher and transducer are arranged so that during the forward movement of the pusher the transducer is lifted to avoid wearing contact with the particle, but during the return stroke the transducer is released to fall onto the particle. The transducer is mounted so that its movement is perpendicular to one of the faces of the Vee groove; this ensures consistent results by ensuring that each particle is

measured against that face. A multiple construction is possible, and an apparatus having 20 feed tubes and transducers could be capable of measuring up to 1000 particles per minute. (UK)

18526 NEUTRON GUIDE-CRYSTAL SYSTEM FOR ISOLATION OF MONOCHROMATIC NEUTRONS IN THE LONG WAVE RANGE. Zhitarev, V. E.; Zelenyuk, F. M.; Stepanov, S. B.; Timakov, A. V. (Moscoe Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1029-1031(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 43-45(1973

The possibility of using standard copper waveguides as neutron-guide systems was investigated. The experiments were carried out by the time-of-flight method. The gain in intensity and efficiency of the neutron guide for neutrons having a waveguide of 3 to 10 Å was measured. It was established that a bent waveguide behaves as an all-wave neutron filter, which allows monoenergetic neutrons to be isolated without the higher reflection orders for $\lambda = 8$ to 14 Å using the synthetic mica fluorphlogopite as the monochromator. (auth)

18527 IMPROVEMENTS OF THE PROPERTIES OF THE RELATIVISTIC PARALLEL PLATE PARTICLE ANALYZER. Proca, G. A. (ESRIN, Frascati, Italy). Rev. Sci. Instrum.; 44: No. 9, 1376-1380(Sep 1973).

Using a three dimensional formalism previously established, the freedom to choose the coupling function g (θ, ϕ) between the polar angles defining the mean trajectory in the field-free region of the analyzer is exploited to improve the properties of the instrument. It is shown that a partial correction to the z variation of the image when θ and ϕ vary can be achieved yielding a maximum excursion $\Delta z/z$ of 6% for a total θ excursion of $\Delta\theta = 18°$ at ϕ = const with a corresponding increase of resolving power by a factor of 2. Indications are also given on the possibility of cylindrization of the focal surface. (auth)

18528 LEAK-FREE GAS-SWITCHING VALVE FOR ISOTOPE-RATIO MASS SPECTROMETRY. James, A. T. (Rice Univ., Houston, TX). Rev. Sci. Instrum.; 44: No. 9, 1405(Sep 1973).

A simple gas-switching valve system for dual feed isotope-ratio mass spectrometry is described, for which no gas mixing exists. (auth)

18529 ANALYZER FOR THE ENERGY AND PHASE DISTRIBUTION OF ELECTRONS IN A BEAM. Bogomolov, A. S.; Zakutov, E. M.; Shebolayev, I. V. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Prib. Tekh. Eksp.; No. 3, 27-30(1973).

A description is given of the design and operation of an analyzer of the phase and energy current-density distributions of the particles in electron guns. The deflecting system consists of two identical cylindrical resonators, called a double resonator. The relative position of the cavities of the double resonator, and their common position with respect to the beam under investigation, is so chosen that at a specific phase shift among the oscillations in the cavities, the double resonator produces circular scanning of the beam on the plane of electron registration, for example on a fluorescent screen. A characteristic feature of the double resonator consists in the fact that two types of fields are used for deflection of the electrons—a transverse magnetic field in relation to the beam, and an electrical one that is longitudinal with respect to the beam; this permits the conduct of precise measurements of electron distribution with respect to the energies in various phase sections of the beam. The analyzer is applicable to electron beams with an energy from 10 to 3000 keV. (JPRS)

18530 USE OF COUNTING CIRCUITS IN RECORDING SYSTEMS FOR PULSED NEUTRON LOGGING. Pamanovskii, V. F. Geofiz. App.; No. 51, 177-179(1973). (In Russian).

The use of counting circuits in the recording apparatus for pulsed neutron logging is discussed. Their use can lead to an increase of the statistical error of the measurement and make sense only in the region of n(t) dependence. (tr-auth)

18531 MEASUREMENT OF THE SENSITIVITY DISTRIBUTION OF PHOTOMULTIPLIERS OVER THEIR ENTRANCE WINDOW. Kellermann, H. J.; Klages, H. O.; Langkau, R.; Paschen, U.; Remen, J. (Univ., Hamburg). Nucl. Instrum. Methods; 115: No. 1, 301-302(1974). (In German).

A method for precise measurement of the sensitivity distribution of photomultipliers over their entrance window is described and typical results are presented. (auth)

18532 BACKGROUND REDUCTION IN X-RAY FLUORESCENCE SPECTRA USING POLARIZATION. Dzubay, T. G. (Environmental Protection Agency, Research Triangle Park, NC); Jarrett, B. V.; Jaklevic, J. M. Nucl. Instrum. Methods; 115: No. 1, 297-299(1974).

X-ray fluorescence spectra are observed by exciting a sample with both polarized and unpolarized radiation. A significant reduction in the magnitude of the scattering peaks and background results from the use of polarization. (auth)

18533 MULTICHANNEL STORAGE CAPACITOR SYSTEM FOR PROCESSING OF FAST SIMULTANEOUS SIGNALS. Ogata, A. (Nagoya Univ., Japan). Nucl. Instrum. Methods; 115: No. 1, 313-316(1974).

A storage capacitor system is described which collects simultaneous signals in a very short sampling time and gives them as an output slowly, in a serial form. (auth)

18534 PACKET OF IDEAL-CRYSTALLINE LAMELLAE AS NEUTRON MONOCHROMATOR. Frey, F. (Univ., Munich). Nucl. Instrum. Methods; 115: No. 1, 277-284(1974).

A monochromator system consisting of perfect silicon crystal lamellae is described. The resolution and the intensity of this lamellae-system can be controlled by choice. It can be used in plane or bent configuration. In case of bent lamellae, some criteria are given for the validity of the dynamical theory of diffraction by bent lattices. In a number of experiments (x-rays' γ-radiation and neutrons), plane and bent lamellae and lamellae-systems are studied. The experimental results prove that packets of lamellae are well suited as neutron monochromators. (auth)

18535 LOW-COST SUB-NANOSECOND PULSE AMPLIFIER. Moore, M.; Newton, G.; Pollard, P. (Univ. of Sussex, Brighton, Eng.). Nucl. Instrum. Methods; 115: No. 1, 181-184(1974).

Fast amplifiers for short-duration nanosecond pulses are described. These provide a bandwidth which is near the limit obtainable with conventional construction techniques and discrete component. Each has a gain of approximately 3.3 and a rise time of 0.7 ns. An output of between 0.5 and 1 V into 50 Ω is achieved. These amplifiers have been used with photomultiplier tubes and electron multipliers. (auth)

18536 CONSTRUCTION OF A NEUTRON SMALL-ANGLE SCATTERING FACILITY FOR THE GRENOBLE HIGH FLUX REACTOR. Degenkolbe, G.; Greiss, H. B. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik; 15: No. 10, 450-457(Oct 1973).

The neutron small angle scattering method makes it possible to study large self-repeating structures with dimensions of a few 10^2 nm. The physical principles, the technical execution, the mode of operation and important technical details of a facility developed for this purpose in Juelich and installed in Grenoble are described. The physical, engineering, radiation protection, and kinematic specifications for the construction of the facility are also discussed. (GE)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

18537 (AECL-4606, pp 16-18) HEAVY WATER PRODUCTION USING HYDROGEN–WATER EXCHANGE. Stevens, W. H.; Blackstein, F. P. (Chalk River Nuclear Labs., Ont.). Win 1973.

The exchange of deuterium between hydrogen and water presents an attractive possibility for the production of heavy water. A key item in this scheme is the development of a suitable catalyst to promote rapid exchange between the liquid water and gaseous hydrogen. Preliminary results of exchange experiments using a catalyst consisting of platinum deposited on alumina pellets with a silicone water-repellent agent applied are reported. The exchange rates were improved by several orders of magnitude. (TFD)

18538 (K-Trans-73) GAS CENTRIFUGE PLANTS FOR THE ENRICHMENT OF URANIUM-235. Groth, W. Translated from Naturwissenschaften; 60: 57-64(1973). 22p. Dep. NTIS $3.25.

After a short historical introduction, the independent work on gas centrifuge development in the German Federal Republic, the United Kingdom, and the Netherlands is discussed as far as classification allows. The Treaties of Collaboration and the Tripartite Organizations for the production of centrifuges and plants and for the operation of the plants are described. An account is given of plants in operation and under construction and of those planned up to 1980. Finally, the economics under European conditions of the gas centrifuge method and other enrichment processes are compared, and the future market for separative work is estimated. (auth)

18539 (MLM-2088) ANALYSIS OF VAPOR PRESSURE RATIO DATA USING WIGNER–KIRKWOOD FREE ENERGY EXPANSION. McConville, G. T. (Mound Lab., Miamisburg, Ohio (USA)). 31 Jan 1974. Contract AT(33-1)-Gen-53. 22p. Dep. NTIS $4.00.

A method is given to find the temperature dependence of the terms in the Wigner–Kirkwood expansion of the free energy difference when applied to the neon isotopes. A standard matrix inversion program was modified to give the best fit to the data using the first three terms of the expansion. The existence of two data sets from the neon-20 to neon-22 and the neon-21 to neon-22 vapor pressure ratios greatly limits the possible form of the terms in the expansion. (auth)

18540 URANIUM ENRICHMENT IN EUROPE. Technol.-Nachr. Manage.-Inform.; No. 125, A-C(1973). (In German).

From discussion meeting of the Atomic Forum; Frankfurt am Main, Germany (19 Jun 1973).

To show the state of the uranium enrichment in Europe, the following processes are discussed: (1) the separation nozzle method, (2) the prospects of gaseous diffusion, and (3) uranium enrichment using centrifugation. (GE)

Isotopic Power Sources

Refer also to abstract 18788.

18541 DESIGN AND EVALUATION OF VENTRICLES FOR THE AEC ARTIFICIAL HEART NUCLEAR POWER SOURCE. Backman, D. K.; Donovan, F. M.; Sandquist, G.; Kessler, T.; Kolff, W. J. (Univ. of Utah, Salt Lake City). Contract AT(11-1)-2155. Trans. Amer. Soc. Artif. Intern. Organs; 19: 542-552 (1973).

Generally, the results obtained are considered quite encouraging. The performance obtained is close to design values and it is believed some modification will yield the desired results. The loss of performance can be attributed to 3 insufficiencies: (1) the ventricle dome is too compliant during the systolic portion of the cycle, having the effect of leaving additional fluid in the pump chamber and reducing available filling volume and consuming power unnecessarily, (2) the ventricle domes are too stiff during the filling (diastolic) portion of the cycle and have the effect of over-filling the heart at low inflow pressures producing more cardiac output than desired. A very flexible but nondistensible ventricle dome is required, and (3) regurgitation and back flow through the closed valves also accounts for a significant reduction in performance and excess power consumption. (auth)

18542 STATUS OF THE USAEC'S NUCLEAR-POWERED ARTIFICIAL HEART. Cole, D. W.; Holman, W. S.; Mott, W. E. (Atomic Energy Commission, Washington, DC). Trans. Amer. Soc. Artif. Intern. Organs; 19: 537-541(1973).

The U. S. Atomic Energy Commission's program to assess the practicability of a fully implantable artificial heart powered by the thermal energy from the decay of plutonium-238 is nearing completion. During the past year, a fully instrumented, nonimplantable but realistically sized, bench model system capable of meeting total heart power requirements was designed, fabricated, and put on test. From the system tests, supplemented by component tests and analytical studies, the characteristics of the optimum thermal converter and blood pump drive system that could be developed in the next few years with present day technology have been synthesized, and a preliminary assessment of practicability made. In the assessment process, isotope inventory, weight, volume, shape, performance, reliability, lifetime, and cost have been the major considerations. (auth)

Radiation Sources

Refer also to abstracts 18283, 18682, 18705, 19904, and 19913.

18543 INVESTIGATION OF DOSE AND SPECTRAL DISTRIBUTION OF GAMMA RADIATION OF COBALT SOURCES IN CIRCULAR CHANNELS. Zyubko, V. A.; Nikolaev, S. A.; Terent'ev, B. M. pp 152-157 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Using as an example curvilinear slits in the form of circular channels, a method for the experimental investigation of the dose and spectral distribution of γ radiation was developed. The dose distribution was measured with respect to both the motion and height of the slit. The dependence of the dose size on setting angle was obtained. The measurement error is 2% as a function of the source–detector distance. The results of the measurement of the spectrum showed that the position of the maximum of the spectral distribution (lying in the region from 150 to 200 keV) does not change with the slit motion. The experimentally obtained results are of interest in the development of engineering methods for the calculation of slits of a given geometry. (tr-auth)

Design and Fabrication

18544 PHOTON SOURCES FOR INSTRUMENT CALIBRATION. Storm, E.; Lier, D. W.; Israel, H. I. (Los Alamos Scientific Lab., NM). Health Phys.; 26: No. 2, 179-189(Feb 1974).

A description is given of the K fluorescent x-rays, heavily filtered x-ray beams, and isotope γ rays used at the Los Alamos X-Ray Facility to measure the energy response of radiation detectors over an energy range of 10 to 1000 keV. Methods of determining beam alignment, size and uniformity are discussed. Exposure, filtration, and spectral measurements of the sources are presented. K x-ray yield and purity in terms of photons, ergs and roentgens are given as a function of accelerating potential. Methods of improving yield and purity are discussed; filter thicknesses which reduce L x-ray intensity to 0.1%, K_β filter thicknesses which reduce K_β/K_α ratios to 0.02, and radiator thicknesses which give maximum fluorescence are calculated. Included are energy response measurements of some typical commercial radiation detectors. (auth)

Industrial Uses

Refer also to abstracts 18053, 18146, 18147, 18156, 18159–18161, 18176, 18184–18187, 18429, 18449, and 18578.

18545 (BARC-712) NUTRITIONAL AND WHOLESOMENESS STUDIES WITH DEHYDRO-IRRADIATED SHRIMP. Aravindakshan, M.; Vakil, U. K.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 61p. Dep. NTIS (U. S. Sales Only) $5.25.

In recent years, it has been amply shown that ionizing radiations can be successfully used for preservation of seafoods. Several promising processes have been developed for shelf-life extension of Bombay duck, shrimp, and pomfret by use of gamma radiation, alone or in combination with thermal treatments. One of these processes, the dehydro-irradiation process for shrimp, which permits extended storage of the product at ambient temperatures, was studied for wholesomeness and nutritional adequacy in feeding experiments with young rats of both sexes and using growth,

reproduction, lactation, longevity, organ histology and other biochemical parameters. Data obtained showed no adverse effects from the feeding of irradiated shrimp (at 25% level in the diet) for four successive generations. (auth)

18546 (CNEA-356) DETERMINATION OF THE TRANSPORT OF MATERIAL IN A ROTATING CEMENT FURNACE USING RADIOISOTOPES. Gomez, H. R.; Cuello, O.; Rey, S. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

In order to determine the residence time and the behavior of solids in a rotating cement furnace $^{140}La_2O_3$ and $^{24}NaHCO_3$ were used to study the behavior of the volatile fraction. This study was done using both tracers simultaneously with the purpose of determining the future mass balances of the materials which become clinkers or escape by the chimneys. The results obtained showed the convenience of using $^{140}La_2O_3$ as a tracer for the solid fraction and proved partial aspects of the dynamics of the $^{24}NaHCO_3$ which contribute to its possible identification with the volatile fraction of the crude material feeding the furnace. (tr-auth)

18547 RADIOISOTOPES AND NUCLEAR RADIATIONS IN MELIORATION AND AGRICULTURAL ENGINEERING. Minkov, B. Ya. Tr. Vses. Nauch.-Issled. Inst. Gidrotekh. Melior.; No. 48, 8-22(1970). (In Russian).

The literature on radioisotopes and nuclear radiations in improving land and water resources is reviewed. (TFD)

18548 USE OF RADIOMETRIC METHODS IN THE PRODUCTION OF SYNTHETIC FIBERS. Merkle, R. Izotoptechnika; 16: No. 11, 593-602(Nov 1973). (In Hungarian).

Radiometric methods are used for level and density gauging in chemical vessels, detection of foam generation, determination of count of yarn, measurement of electrostatic charge, and fire warning. (auth)

18549 RADIATION EFFECTS ON METABOLIC SYSTEMS ACTIVATED BY K^+. Rink, H.; Bergeder, H. D. (Univ., Bonn). (1973). vp. (In German).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

A model investigation was made of the aldehyde dehydrogenase in yeast in order to determine whether the radiation-induced loss of K^+ ions will have different effects on the cell metabolism, depending on the K^+ activation of a reaction. This enzyme is activated by K^+ ions and is inhibited by an excess amount of substrate, with the K^+ activation decreasing with increasing substrate inhibition. This system was chosen as it allows the K^+ content and K^+ activation to be varied within a wide range and therefore lends itself to a more differentiated study of the effects of radiation-induced losses of K^+ ions. Different substrate concentrations and extracellular K^+ concentrations were used for the experiment and it was found that irradiation with 200 kR always results in a loss of K^+ ions of equal order of magnitude, in spite of the variation of parameters. The same amount of lost K^+ ions, however, caused various changes in the respiration rate, depending on the substrate concentration. The results show that equal K^+ losses will have a different effect that depends on the ability of the system under investigation to be activated by K^+ ions. Radiation-induced losses of K^+ ions will have only a minor effect on O_2 consumption if the system's activation by K^+ ions is weak, whereas in the opposite case, already small losses of K^+ ions will induce considerable changes in O_2 consumption. (GE)

18550 IDENTIFICATION OF IRRADIATED FOOD: STATE OF DEVELOPMENT OF RESEARCH WORK CARRIED OUT WITHIN THE FRAMEWORK OF A JOINT EUROPEAN PROGRAMME. Deschreider, A. R. (Ministere des Affaires Economiques, Brussels). (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

A survey is given of the research work carried out so far in the field of food irradiation from the beginning in 1959 to the present. Legal aspects as well as the need for unambiguous test methods for the detection of irradiated food are discussed. Currently known methods such as electron spin resonance and infrared spectroscopy, spectropolarimetry, electrophoresis, gas chromatography, histochemical investigations and measurements of the electric conductivity are explained by means of examples. It is concluded that despite numerous good test results, much work will be necessary before the desired goal will be achieved. (GE)

18551 CONDUCTIVITY MEASUREMENTS AS A METHOD FOR DIFFERENTIATION BETWEEN IRRADIATED AND NONIRRADIATED POTATOES. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Irradiation causes a decrease of the electrical conductivity of potatoes which is dependent on the potato variety. It was further observed that with unirradiated potatoes, the conductivity decreases immediately after inserting the electrodes into the tubers until constant values of conductivity are reached after three minutes. This initial decline of conductivity is less pronounced in irradiated tubers and disappears completely in potatoes irradiated with doses above 50 krad. This effect of irradiation is nearly independent of variety and storage conditions. It permits distinction between irradiated and unirradiated potatoes as long as the latter remain unsprouted. (GE)

18552 IDENTIFICATION OF IRRADIATED STRAWBERRIES. Deschreider, A. R. (Ministere des Affaires Economiques, Brussels); Vigneron, J. M. (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Packaged strawberries were irradiated with doses of 100, 200, and 500 krad of ^{60}Co gamma rays. The irradiation of the fruit at these levels could not be detected either by measuring of the coloration of the anthocyanin extraction or the radioactivity of the phenylalanine-ammonia-lyase. If there is any plastic in the packaging material, examination under close infrared light reveals spectral modification when the dose level reaches 200 krad. (GE)

18553 INVESTIGATION OF THE IDENTIFICATION OF IRRADIATED SHRIMPS AND CODFISH. Deschreider, A. R. (Ministere des Affaires Economiques, Brussels); Vigneron, J. M. (1973). vp. (In French).

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Germany (24 Oct 1973).

Type Crangon vulgaris shrimps were irradiated with 100, 250 and 500 krad of gamma rays several hours after the catch. It was found that, although spectropolarimetry given lower optical rotation values after irradiation, it can only be used for comparative studies. A distinction between irradiated and nonirradiated shrimps can only be made by taking infrared spectra readings, as the effect of irradiation is to lower the absorption peak at 3.40 microns and to eliminate it at 3.43 microns. The limit for detection seems to be around 100 krad. In regard to codfish irradiated with doses of 100, 200, and 500 krad, differences from the control sample could not be detected either by infrared light or by spectropolarimetry. Where part of the fish packaging consists of polystyrene, the difference in infrared spectra is shown by a wide and very clearly defined absorption spectrum at the level of 500 krad, this being the minimum level at which it can be detected. (GE)

18554 FIRST EXPERIENCES WITH A ^{252}Cf IRRADIATION LOOP FOR USE IN PROCESS ANALYSIS. Braun, H.; Riffel, F. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From 4th seminar on activation analysis of the Bundesanstalt fuer Materialpruefung; Berlin, Germany (11 Oct 1973).

An irradiation loop for the application of activation analysis in industrial on-line process control has been developed. A 1-mg ^{252}Cf source is used for neutron production. The optimization of the parameters affecting the flow rate in the loop is discussed. (GE)

LIFE SCIENCES

18555 (CONF-731051-(Absts.)) 4th AINSE RADIATION BIOLOGY CONFERENCE, LUCAS HEIGHTS, OCTOBER 15–16, 1973. Abstracts of Papers. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 1973. 26p.

18556 PROCEEDINGS OF THE THIRTEENTH INTERNATIONAL CONGRESS OF GENETICS, BERKELEY, CALIFORNIA, AUGUST 20–29, 1973. Abstracts. Genetics, Suppl.; 74: No. 2, Suppl., s1-s313(Jun 1973).

From 13th international congress of genetics; Berkeley, CA (20 Aug 1973).

Radiation Effects on Biochemicals

Refer also to abstracts 18154, 18633, and 18637.

18557 INFLUENCE OF THE RADIOSENSITIZERS PARA-NITROACETOPHENONE AND TRIACETONEAMINE-N-OXYL ON THE EFFECTS OF IONIZING RADIATION ON DNA. Van Hemmen, J. J.; Meuling, W. J. A.; Bleichrodt, J. F. (Rijksverdedigingsorganisatie TNO, Rijswijk, Netherlands). Int. J. Radiat. Biol.; 24: No. 6, 569-580(Dec 1973).

Paranitroacetophenone (PNAP) and triacetoneamine-N-oxyl (TAN), which sensitize anoxic cells to ionizing radiation, did not increase the radiosensitivity of bacteriophage DNA irradiated in the dry state. It is suggested that this shows the 'direct action model' of sensitization does not hold in this experimental set-up. PNAP and TAN added within 1.5 msec after irradiation of the DNA in buffer, did not decrease the survival of biological activity, indicating that any reaction between these compounds and 'long-lived' DNA radicals is not lethal. When DNA was irradiated in solution in the presence of TAN, part of the damage in DNA was reparable by the excision repair system of Escherichia coli. Such an effect was not observed with PNAP. In protective media PNAP and TAN also behaved differently with regard to the inactivation of phage T_1. Like oxygen, PNAP protected the phage a bit and decreased the difference in survival on a Uvr^+ and a Uvr^- strain of E. coli. TAN sensitized T_1 and increased the difference on the two strains. Induction of mutations in phage by radiation, which is often enhanced by O_2, was not significantly affected by the presence of the sensitizers. (auth)

18558 EFFECT OF ULTRAVIOLET IRRADIATION OF DNA ON THE DISSOCIATION TRANSITION OF THE STRONG DNA-ACRIFLAVINE COMPLEX. Roth, D. (New York Univ., NY). Photochem. Photobiol.; 18: No. 5, 437-439(Nov 1973).

Fluorescence quenching was used as an expression of intercalative dye binding in an examination of the effects that prior ultraviolet irradiation of DNA has upon the dissociation transition of its complex with acriflavine. The term dissociation transition is applied to the biphasic thermal dissociation kinetics exhibited by DNA complexes with intercalating cations. At room temperatures the dye showed intercalative binding to denatured and native DNA. When bound to single-stranded DNA in the incompletely intercalated complex, its thermal dissociation slope was linear over the 25 to 60°C range; the free dye levels of fluorescence were restored at 60°C. The dissociation curve of the double-stranded complex was biphasic, exhibiting a low rate of increase in fluorescence yield at low temperatures, a transition region at ~60°C, and thereafter a rapid increase. These results were taken to indicate that dye fluorescence values at 60°C could be used to discriminate between single-stranded and double-stranded DNA–acriflavine complexes in the region of A–T pairs. It is suggested that the 27% and 88% increases in fluorescence yield at 60°C, which developed with the two experimental uv doses, may be crude expressions of the number of dimers formed between adjacent thymine residues. (UK)

18559 EFFECT OF ENVIRONMENT IN THE IRRADIATION OF DNA WITH FAST ELECTRONS OF DIFFERENT ENERGY SPECTRA. Elmshaeuser, H. J. (Univ., Gottingen, Ger.). (1973). vp.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

The effect of oxygen, nitrogen, air as well as 0.4 m NaCl on the change of uv absorption in the irradiation of DNA with fast electrons was investigated. In all cases examined, the Na ions have a protecting effect. In the presence of Na ions, O_2 has a protecting effect; in the absence of Na ions, on the other hand, O_2 has a sensitizing effect. Deep irradiation showed a more marked change of uv absorption only in the presence of oxygen and absence of Na^+, and a lesser change of the uv absorption in the presence of Na^+, compared with surface irradiation. (GE)

18560 INVESTIGATIONS ON THE PRIMARY EFFECT OF UV-IRRADIATION: IMPORTANCE OF FREE RADICALS FOR THE UV-INACTIVATION OF ENZYMES. Nemec, H. W. (Univ., Freiburg, Ger.). (1973). vp. (In German).

From fourth scientific meeting of the Deutsche Gesellschaft fer Medizinische Physik eV; Homburg, Germany (4 Oct 1973).

A method for the uv irradiation of enzyme suspensions is described that allows a simple determination of the energy absorbed by the enzyme. The uv irradiation of trypsin in oxygen-free suspensions yields results similar to irradiation under vacuum. Long-lived free radicals were detected in trypsin by means of ESR spectroscopy after irradiation at 278 K. The unpaired electrons are mainly located at the C_α atoms of the polypeptide chain and at sulfur atoms of the cystine residue. Apart from the ESR measurements, the decrease in the enzymatic activity was investigated, as well as the quantum yield for the radical formation and the inactivation. The low amount of 0.07 radicals per inactivated molecule seems to indicate that the long-lived free radicals themselves have no effect on the inactivation of the enzyme but rather point to the fact that damage has already occurred. An analysis of these radicals, however, allows conclusions to be made on the extent of the radiation effect, as an increasing yield of sulfur radicals goes hand in hand with an increased inactivation quantum yield. Both radiation effects are mainly associated with the formation of primary sulfur radicals. Different transfer mechanisms are assumed to induce the formation of secondary sulfur radicals of the type RS' from the primary radicals. From the present results it can be concluded that the disulphide break is of particular importance for the inactivation. This disulphide break can be caused by the absorption by the cystine residues and above all by the quanta absorbed by the tryptophane residues. Another possible conclusion is that reactions leading to the formation of cross bonds take part in enzyme inactivation. (GE)

18561 INFRARED SPECTROSCOPY OF THE PHOTO- AND RADIOBIOLOGY OF DNA BASES AND THEIR DERIVATIVES. Marcus, M. A.; Corelli, J. C. (Rensselaer Polytechnic Inst., Troy, NY). Radiat. Res.; 57: No. 1, 20-37(Jan 1974).

Infrared spectroscopy for wavenumbers ranging from 10,000 to 300 cm^{-1} is used to study the action of ionizing radiation (0.8 MeV electrons) and nonionizing ultraviolet light (Hg lamp 2537 Å) on thin solid film samples of purines, pyrimidines, and their derivatives. Data indicate that of all the bases studied only pure uracil is highly resistant to electron irradiation, whereas all the other bases and their derivatives including uracil derivatives damage readily. Damage is exhibited by bond breaking manifested by decreases in intensity of various absorption peaks, or by the appearance of new absorption peaks indicative of new groups. Intense new absorption peaks in the region of 1100 to 1400 cm^{-1} appear in thymine, uracil, 1-methyl thymine, and deuterated thymine and uracil subsequent to uv irradiation. Low temperature spectra were taken and inert atmosphere uv irradiations were tried using thymine. There are distinct differences between irradiation effects of uv light and 0.8 MeV electrons indicating selectivity of damage sites at various parts of the biomolecules. (auth)

Radiation Effects on Cells

Refer also to abstracts 18639 and 18650.

18562 DO MURINE LYMPHOMA CELL POPULATION SURVIVE SUPRALETHAL DOSES OF X-RAYS? Beer, J. Z.; Szumiel, I. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

Murine lymphoma cultured cells were γ-irradiated with doses ranging from 800 to 30,000 rads. When the medium was replaced after irradiation, all cultures irradiated with doses up to 6000 rads survived and some of them were viable after irradiation with 10,000, 20,000 and 30,000 rads. When the cells remained in the irradiated medium some of the cultures failed to grow after 2000, 3000, and 5000 rads. The results indicate that at the doses applied the harmful effect of the irradiated medium contributes significantly to the final effects radiation. It is also concluded that in the higher dose range when more than a single cell survived the progeny of the surviving cells were able to proliferate normally. (auth)

18563 INFLUENCE OF THE SIZE OF THE ADMIXTURE OF IRRADIATED CELLS ON THE REVESZ EFFECT. Dawson, K. B. (Royal Marsden Hospital, Sutton, Eng.). Int. J. Radiat. Biol.; 24: No. 4, 413-415(Oct 1973).

Various numbers of viable cells of a rat fibrosarcoma were injected into rat recipients, on their own or mixed with 50,000 or 100,000 irradiated cells. Tumor palpability time was plotted against cell numbers and the Revesz effect was shown to be an all-or-none response; an admixture of 50,000 irradiated cells had no effect on the growth of the viable cells but with 100,000 irradiated cells there was a clearly marked response. With another cell clone from the original tumor, 100,000 irradiated cells did not produce an effect, but 200,000 cells did. In experiments with irradiated cells given intradermally or intraperitoneally, at differing times from the viable cells, no Revesz effect was observed, except when the cells were given together and intradermally. Rats which had had tumors surgically excised, and 10 days later had an injection of viable cells at an adjacent site, showed no difference in palpability time from a group where viable cells were injected into tumor-bearing rats, and a group given the same number of cells intradermally. When viable cells were injected into hosts that had received 500 rads whole-body irradiation in two fractions three days before, there was a just significant difference in palpability time compared with similarly injected unirradiated hosts. Mixing viable cells with various sera caused no change in palpability time, compared with cells suspended in growth medium. (UK)

18564 RADIOSENSITIVITY OF SURVIVING CELLS IN TUMORS PRETREATED WITH CONTINUOUS IRRADIATION. Kal, H. B.; Barendsen, G. W. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). Brit. J. Radiol.; 46: No. 552, 1083(Dec 1973).

Brief reply is made to criticism of a previous paper (Kal, H. B., and Barendson, G. W., Br. J. Radiol. 46, 279-283(1973)). It is argued that the greater irradiation response of surviving cells in tumors pretreated at low dose rates is not entirely due to accumulation of sublethal damage during protracted treatment, as suggested by W. E. Liversage (Br. J. Radiol. 45, 564-565(1973)). It is suggested that rapid reoxygenation and changes in cell age distribution also play a part in differences of cell response. Observations of changes in DNA content of rhabdomyosarcoma cells are used to illustrate the latter factor. (UK)

18565 EFFECT OF OXYGEN ON DNA STRAND BREAKS IN IRRADIATED THYMOCYTES. Lennartz, M.; Coquerelle, T.; Hagen, U. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 24: No. 6, 621-625(Dec 1973).

Single and double-strand breaks were determined in DNA of rat thymocytes irradiated with 10-MeV electrons over a range of 0 to 6 Mrads in the presence of O_2 or N_2, under rapid conditions where the repair of breaks should have been negligible. The numbers of double and single strand breaks in irradiated cells increased linearly with dose. The ratio between single and double strand breaks was 19.5 ± 1.3 in DNA from cells irradiated under O_2 and N_2. DNA from irradiated cells contained fewer single-strand breaks after heating than after alkaline denaturation. The frequency of single strand breaks in unirradiated DNA was identical after both methods of denaturation. The ratio of the slopes of the dose-effect curves yielded 27.8% ± 3.8% alkali labile breaks under O_2 and 49.8 ± 4.7% under N_2. An o.e.r. of ~3.7 was deduced from these results for the initial yield of single- and double-strand breaks in irradiated mammalian cells. (UK)

18566 EFFECT OF THE MEDIUM ON POST-IRRADIATION CHANGES IN BULL SPERMS. Horakova, A. (Vysoka Skola Veterinarska, Kosice, Czech.); Horak, J. Folia Vet.; 15: No. 3-4, 77-82(1972). (In Slovak).

The effect of x radiation on bull sperm was studied using exposed sperm resuspended in non-irradiated media (nutrient plasma or saline) and on non-irradiated sperm resuspended in irradiated media. The radiation effect was found to be most pronounced on exposed sperm suspended in the exposed medium; the effect decreased as a result of the resuspension of exposed sperm in non-irradiated medium. X radiation was found to affect the bull sperm not only directly but also via the vehicle in which the sperm was suspended. (INIS)

18567 ROLE OF THE METABOLIC EFFECTS OF CYSTEINE ON THE ENHANCEMENT OF CELLULAR RADIORESISTANCE. II. Effects on the Hemo-Lymphopoietic System. Hernadi, F.; Kovacs, P. (Orvostudomanyi Egyetem Gyoergyszertani Intezete, Debrecen, Hungary). Isotoptechnika; 16: No. 11, 603-610(Nov 1973). (In Hungarian).

A single intraperitoneal dose of 1000 mg/kg L-cysteine-HCl increased the radiation resistance of endogenous spleen colony forming units in mice. In addition other alterations in the hemolymphopoietic system were observed during the 10 days following administration. As the radiation resistance of the whole animals was not elevated during this time but 30 min after cysteine injection, changes are not likely to be correlated to the radioprotective effects of cysteine on the whole animal. The inhibition of bone marrow DNA synthesis, however, observed 30 min after administration, may play a role in radioprotection. (auth)

18568 CHROMOSOME ABERRATIONS INDUCED BY ULTRAVIOLET RADIATION. Wolff, S. (Univ. of California, San Francisco). Photophysiol. Curr. Top.; 7: 189-205(1972). (UCSF-10-P-2-176).

In recent years, studies with uv on the induction of chromosome aberrations have centered on work with mammalian cells in tissue culture. Such cultured cells have many characteristics that make them more suitable than plants for ultraviolet studies. Dosimetric problems are minimized and difficulties arising from complex biological responses can be analyzed. The problems that still exist, even with cultured cells, are so formidable, however, that we have not as yet been able to realize the full potential uv holds for understanding the nature of those radiation-induced mutagenic events manifested as chromosome aberrations. Nevertheless, the use of uv still holds its promise for such understanding, and as the responses of cultured cells become better understood, we can anticipate that uv will become increasingly important in studies of radiation-induced chromosome breakage. (auth)

18569 QUANTITATIVE DESCRIPTION OF THE CELL RADIATION INACTIVATION. III. Recovery of Cells from Sublethal Radiation Lesions. Method of Fractionated Exposure. Barsukov, V. S.; Malinovskii, O. V. (Inst. of Nuclear Physics, Moscow). Tsitologiya; 15: No. 11, 1405-1414(Nov 1973). (In Russian).

Dependence of cell survival on the dose of radiation and on the interval between two equal exposure fractions was recorded. Kinetics of sublethal recovery and the way of estimation of the average time-life of sublethal is described. A nomogram for estimation of the maximal dose-fractionation effect is proposed in relation to dose values and survival curve parameters. (auth)

18570 RADIATION HEMOLYSIS AT DIFFERENT TEMPERATURES. Eberstadt, P.; Coo, J. (Universidad Nacional Autonoma de Mexico, Mexico City). Int. J. Nucl. Med. Biol.; 1: No. 2, 95-98(Nov 1973).

In suspensions of red blood cells in isotonic saline the rate of hemolysis is increased by exposure to gamma radiation from a ^{60}Co source, at doses of 10, 20, 30, and 40 krad. The rate of production of hemolysis under the above mentioned conditions bore a direct relationship with the amount of radiations delivered. When the aforementioned erythrocytes were maintained at constant temperature throughout the observation period and different series at different temperatures, but previously subjected to identical irradiation doses, an interesting sequence could be observed. The rate of hemolysis decreased in the present observation as temperature increased up to 28°C, from then on, up to 40°C it increased. The studies had to be concluded under sterile conditions, bacterial contamination, leading to apparently paradoxical results. (auth)

18571 CYCLIC RADIATION-INDUCED VARIATIONS IN CELLULAR RADIOSENSITIVITY IN A MOUSE MAMMARY TUMOR. Rockwell, S.; Kallman, R. F. (Stanford Univ., CA). Radiat. Res.; 57: No. 1, 132-147(Jan 1974).

Solid EMT6 tumors in BALB/cKa mice were irradiated with split doses: first, 150, 300, or 600 rads given locally to the tumors and, second, 600 rads delivered to tumors rendered hypoxic by asphyxiating the hosts with nitrogen. Cell survival, assayed by colony formation in vitro, revealed a cyclic pattern of cellular radiosensitivity as a function of the time between the two doses of radiation. The cycles persisted for at least 40 hr and had a periodicity of 10 to 12 hr. No evidence was found for circadian rhythms in tumor radiosensitivity. The age-response function of EMT6 cells was determined in vitro using synchronous cell populations obtained by mitotic selection and was characterized by two periods of radiosensitivity (early G_1 and the G_1/S transition) and two periods of resistance (mid G_1 and S/G_2). The percent labeled mitosis method revealed no significant effect of 300 rads on cell kinetic parameters when tumors were irradiated 24 hr prior to intraperitoneal injection of ^{3}HTdR. The periodicity of the cyclic radiosensitivity variations was in agreement with that predicted for a synchronous cohort of surviving cells moving through the different states of radiosensitivity characteristic of the cell cycle. The possibility of radiation-induced synchrony in the surviving cell population and the implications of such a phenomenon in the clinical situation are discussed. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 18146, 18147, 18159–18161, 18176, 18184–18187, 18367, 18570, and 19675.

18572 EFFECT OF ASCORBATE ON RADIOSENSITIZATION OF BACTERIAL CELLS. Joshi, D. S.; Singh, B. B.; Gopal-Ayengar, A. R.; Ehrenberg, L. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol.; 24: No. 6, 631–635(Dec 1973).

The effect of ascorbate on the radiosensitization of Escherichia coli by 10^{-3} M KI was investigated over a concentration range of 0 to 10^{-2} M. The sensitization effect was reduced in the presence of ascorbate with increasing dose, but no additional protection was observed against radiation lethality. Irradiation of cells in the presence of NaI^{131} showed a decrease in cell radioactivity with increasing concentration of ascorbate present during irradiation over a concentration range of 0 to 10^{-3} M. It is argued that ascorbate reduced the sensitizing effect by scavenging the iodine atoms which would have otherwise reacted with the cells. The sensitization by 10^{-3} M 2,2,6,6-tetramethyl-4-piperidone-N-oxyl (TAN) decreased with increasing concentration of ascorbate, but no net protective effect was noticed. It is suggested that a reaction between the two molecules took place because the optical absorption of ascorbate (10^{-4} M) at 265nm decreased to half its value in the presence of equimolecular TAN, and also because the esr signal from 1 mM TAN decreased to a fifth of its value in 15 min after mixing with equimolecular solution of ascorbate. The presence of ascorbate during irradiation at concentrations from 10^{-6} M to 10^{-3} M did not affect the radiosensitization of anoxic E. coli cells by 5×10^{-5} M of N-ethylmaleimide (NEM). (UK)

18573 MULTIPLICITY EFFECT ON THE SURVIVAL OF ULTRAVIOLET-IRRADIATED HERPES SIMPLEX VIRUS. Coppey, J.; Necentini, S. (Inst. of Radium, Paris). Int. J. Radiat. Biol.; 24: No. 6, 645–647(Dec 1973).

Considerable multiplicity effect (ME) occurred during the first viral cycle of uv-irradiated Herpes simplex virus in stationary cultures, irrespective of dose (range 0 to 4500 erg/mm^2), but only for multiplicity of infection (m.o.i.) higher than 0.1. Dose-response curves are presented for m.o.i. of 10, 1, 0.1, and 0.01. (UK)

18574 BIOSTACK, A RADIOBIOLOGICAL EXPERIMENT OF THE APOLLO 16 SPACEFLIGHT. Buecker, H.; Horneck, G. (Univ., Frankfurt am Main). Atomkernenergie; 22: No. 2, 77–83 (Oct 1973). (In German).

The objective of the Biostack experiment, which was flown aboard the Apollo 16 command module, was to study the biological effects of individual heavy primaries of cosmic radiation. This was achieved by using a special sandwich construction, where physical detector sheets were stacked alternately with layers of biological objects in monolayers. Thus, it was possible to correlate each observed biological damage with the responsible heavy primary of known charge and energy loss. A broad spectrum of radiation-induced effects was observed on bacterial spores, plant seeds, and animal eggs. The severest damage was produced in shrimp eggs, which were hit by a heavy primary. None of the hit eggs developed to a normal adult. Development inhibition, malformations, and reduced fertility were the main effects observed. The information about the biological effectiveness of heavy primaries, obtained from the Biostack experiment, helps to estimate the radiation hazards of man in space during long-duration missions. (auth)

18575 SENSITIVITY OF CHLOROPHYLL FORMATION AND OF INCREASE OF NADP-DEPENDENT GPD-ACTIVITY IN GREENING EUGLENA GRACILIS TO X RAYS AND TO OTHER INHIBITORS OF PROTEIN SYNTHESIS. Simonis, W.; Seuberling, H. B. (Univ., Wuerzburg, Ger.). Atmos. Environ.; 13: No. 5, 297-300(Nov 1973).

The effect of x rays on the formation of chlorophyll, and on the activity of NADP-linked glyceraldehyde-3-phosphate dehydrogenase (GPD) was investigated in non-dividing, dark-grown colorless Euglena gracilis (strain Z), during exposure to light. The increase after 48 h of both chlorophyll and GPD activity was severely inhibited by x rays over a range 0 to 80 krad. The activity of the GPD already present was not inhibited by doses of up to 65 krad. Inhibitors of translation, actinomycin C at 134 γ/ml, actinomycin D, 5-fluorouracil at 1.5×10^{-2} M, and rifampicin at 250 γ/ml did not significantly influence the synthesis of chlorophyll and GPD. (UK)

18576 PRODUCTION AND DEFENSIVE ROLE OF INTERFERON. Babbar, O. P.; Singh, D. P.; Khan, S. K. (Central Drug Research Inst., Lucknow, India). Indian J. Exp. Biol.; 11: No. 3, 194-198(May 1973).

Kinetics of production of an interferon in cell cultures, chick embryos, chickens and rats showed that its yield may vary markedly, but the pattern of the production was similar. In rats the circulatory interferon appeared as early as 6 hr after induction by live or uv-irradiated Ranikhet disease virus while in chicken it may persist up to 72 hr. The presence of the circulatory interferon in rat and chicken was not accompanied by the appearance of virus specific antibodies, which could not be demonstrated before 7 days. This suggests that the interferon may have some protective role in absence of antibodies. (auth)

18577 EFFECT OF INTERFERON ON TUMOR FORMING ABILITY OF WALKER CARCINO-SARCOMA 256 CELLS AND SECRETION OF EXOTOXIN BY THE BACILLUS, CLOSTRIDIUM WELCHII (TYPE C). Babbar, O. P.; Singh, D. P.; Bajpai, S. K. (Central Drug Research Inst., Lucknow, India). Indian J. Exp. Biol.; 11: No. 3, 199-206(May 1973).

Interferon (exogenous or endogenous) induced by Ranikhet disease virus could block specifically the tumor forming ability of Walker Carcino-sarcoma 256 (WM-256) cells in rats and would also decrease markedly the secretion of exo-toxins by Clostridium welchii (type C), without altering their other potentialities. In rats interferon had twofold activity, the blocking of the tumor forming ability of WM-256 cells as well as stimulating the non-specific defence system, which could control or even cure malignant tumor growths. (auth)

18578 RADIATION TECHNOLOGY OF DRUGS. Schwenker, G. (Karlsruhe Univ., Ger.). Pharm. Ind.; 33: No. 6, 378–385 (1971). (In German).

The irradiation of drugs with ionizing radiations would be a possibility to meet the microbiological quality standards during their production. At this time, the prohibition of application of irradiation by paragraph 7 AMG opposes this procedure, with the exception of a limited number of products, which since then have been subjected to radiation treatment on a large industrial scale. Hence the microbiological and technological basis for a more extensive application of this method has been gained and is explained in some detail in this article. The main problem of application of radiation technology to drugs, however, is the interaction between irradiating energy and the irradiated matter, which leads to radiolytic processes that probably may influence efficacy, toxicity, and stability of the drugs. Their quantitative extent may be estimated and is, in most cases, very small. However, apart from a series of publications concerning this subject, extensive investigations establishing a base for technological employment of this method are missing and must, therefore, be undertaken. The difficulties encountered with presumably concern the analytics that cannot use the hitherto existing quality standards. The large number of the possible radiolysis products and their mostly very small concentrations may put high demands on the analytical methods available. (GE)

18579 DOSIMETRIC SUBSTANTIATION OF STERILIZATION OF RADIOPHARMACEUTICAL PREPARATIONS. Bochkarev, V. V.; Tushov, E. G.; Pavlov, E. P.; Khrushchev, V. G.; Sedov, V. V.; Komlyarov, L. M. (Inst. of Biophysics, Moscow). Med. Radiol.; 18: No. 12, 34-38(Dec 1973). (In Russian).

The effectiveness of radiosterilization for insuring the safety of radiopharmaceuticals injected into patients was evaluated. The radiosensitivity of microorganisms contaminating the preparations and industrial premises in which they were produced was determined. It was concluded that the sterilizing doses for preparations with an initial contamination of 10^1 and 10^2 bacterial cells were 0.56 and 0.67 mrad respectively. (auth)

18580 ISOLATION AND CHARACTERIZATION OF AN ESCHERICHIA COLI RUV MUTANT WHICH FORMS NON-SEPTATE FILAMENTS AFTER LOW DOSES OF ULTRAVIOLET LIGHT IRRADIATION. Otsuji, N.; Iyehara, H.; Hideshima, Y. (Kyushu Univ., Fukuoka). J. Bacteriol.; 117: No. 2, 337-344 (Feb 1974).

Two ultraviolet light (uv)-sensitive mutants have been isolated from Escherichia coli K-12. These mutants, designated RuvA$^-$ and RuvB$^-$, were controlled by a gene located close to the his gene on the chromosome map. They were sensitive to uv (10- to 20-fold increase) and slightly sensitive to gamma rays (3-fold increase). Host cell reactivation, uv reactivation and genetic recombination were normal in these mutants. Irradiation of the mutants with uv resulted in the production of single-strand breaks in deoxyribonucleic acid, which was repaired upon incubation in a growth medium. After uv irradiation, these mutants resumed deoxyribonucleic acid synthesis at a normal rate, as did the parent wild-type bacteria, and formed nonseptate, multinucleate filaments. From these results we concluded that the mutants have some defect in cell division after low doses of uv irradiation, similar to the lon$^-$ or fil$^+$ mutant of E. coli. The ruv locus

was divided further into ruvA and ruvB with respect to nalidixic acid sensitivity and the effect of minimal agar or pantoyl lactone on survival of the uv-irradiated cell. The ruvB$^-$ mutant was more sensitive to nalidixic acid than were ruvA$^-$ and the parent strain. There was a great increase in the surviving fraction of the uv-irradiated ruvB$^-$ mutant when it was plated on minimal agar or L agar containing pantoyl lactone. No such increase in survival was observed in the ruvA$^-$ mutant. (auth)

18581 EVIDENCE RELATING CESSATION OF RESPIRATION, CELL ENVELOPE CHANGES, AND DEATH IN ULTRAVIOLET-IRRADIATED ESCHERICHIA COLI B/r CELLS. Swenson, P. A.; Schenley, R. L. (Oak Ridge National Lab., TN). J. Bacteriol.; 117: No. 2, 551-559(Feb 1974).

Ionic and nonionic detergents have little effect on respiring bacteria, but in cultures poisoned with KCN rapid solubilization of the cell membrane, as indicated by turbidity losses, takes place. Ultraviolet radiations cause Escherichia coli cells grown in minimal medium with glycerol as a carbon source to cease respiring and growing about 1 h after irradiation. The effect of the nonionic detergent Triton X-100 on growth and cell membrane dissolution (both measured by turbidity changes), respiration, and viability of unirradiated and irradiated E. coli B/r cells was tested. When the detergent was added to cells immediately after irradiation, a decrease in turbidity occurred only when respiration was about to cease; when it was added after cessation of respiration, the turbidity loss was immediate. In both cases the turbidity loss was about 60%, and disintegration of the cell walls did not take place. 5-Fluorouracil (FU) and thermal (42 C) treatments caused respiration of irradiated cells to be maintained and also caused viability increases. Irradiated cells treated with FU and detergent showed no turbidity loss just prior to the time respiration normally ceases, but a loss did occur in irradiated cells incubated with detergent at 42°C. It was concluded that FU maintains respiration for all the cells, but that thermal treatment maintains respiration for only part of the cells. In all cases the detergent had only a negligible effect on the respiration and viability of unirradiated and irradiated cells. Triton X-100 causes solubilization of cell membranes of only nonrespiring cells that are not destined to survive. (auth)

18582 SEPARATE BRANCHES OF THE UVR GENE-DEPENDENT EXCISION REPAIR PROCESS IN ULTRAVIOLET-IRRADIATED ESCHERICHIA COLI K-12 CELLS; THEIR DEPENDENCE UPON GROWTH MEDIUM AND THE polA, recA, recB, AND exrA GENES. Youngs, D. A.; van der Schueren, E.; Smith, K. C. (Stanford Univ. School of Medicine, CA). J. Bacteriol.; 117: No. 2, 717-725(Feb 1974).

The extent of repair of single-strand breaks (incision breaks) induced in the deoxyribonucleic acid (DNA) of Escherichia coli K-12 cells by the uvr gene-dependent excision repair process after ultraviolet (uv) radiation was determined in the wild-type, polA1, recA56, recB21, and exrA strains. The wild-type strain repaired all incision breaks after incident doses of uv radiation (254 nm) of ~60 J m^{-2} or less when incubated in growth medium, or ~15 J m^{-2} or less when incubated in buffer. The polA1 strain repaired the incision breaks completely after incident doses of ~12 J m^{-2} or less when incubated in growth medium, or after ~4 J m^{-2} when incubated in buffer. The recA13, recB21, and exrA strains showed essentially complete repair after incident doses of 10 to 15 J m^{-2} whether the cells were incubated in buffer or growth medium. These results suggest that the uvr gene-dependent excision repair process may be divided into two branches, one which is dependent on the presence of growth medium and also the rec$^+$ exr$^+$ genotype, and a second which can occur in buffer (growth medium-independent) and is largely dependent on DNA polymerase I. The presence of chloramphenicol in the growth medium resulted in an inhibition of the growth medium-dependent repair occurring in wild-type and polA1 cells and had little or no effect on the extent of repair observed in recA56, recB21, or exrA cells. The similarities between the growth medium-dependent and -independent branches of excision repair and two known processes for the repair of x-ray-induced single-strand breaks are discussed. (auth)

Radiation Effects on Plants

Refer also to abstracts 18574, 18606, 20517, and 20535.

18583 (INIS-mf-732) RADIOSTIMULATING EFFECT ON TOMATOES, PEPPER, AND EGGPLANTS OBTAINED AFTER IRRADIATION OF THE SEEDS WITH LOW DOSES OF ^{60}Co GAMMA RAYS. Daskalov, Kh.; Maltseva, S. (Komitet za Mirno Ispolzvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 13p. (In Bulgarian). INIS.

The possibilities for exciting stimulation by presowing irradiation of dry tomato, pepper and eggplant seeds with low doses of ^{60}Co gamma rays were studied. Dry seeds with equalized moisture content in advance were irradiated in a gamma unit of IGSR GUPE-4000 with a radiation power of 46-39 R/min. The sowing was carried out immediately after irradiation and prickling out and planting in time in green house (during the autumn-winter period) and in the field (during the summer). The results obtained show that after presowing irradiation of dry tomato, pepper and eggplant seeds with low doses of gamma rays ^{60}Co a stimulating effect is observed manifested in a higher index of early maturity in the first harvests after which gradually decreases and the irradiated varieties equalize in the yield with the controls. The rise of the index of early maturity is in the limits of about 15 to 30% on an average. The following most appropriate stimulating doses are established for greenhouse and field conditions in the region of Sofia: for eggplant, 2500 to 3000 R; for tomatoes, 1500 to 2000 R; for pepper, 1200 to 1600 R. (INIS)

18584 IVY LEAF OF POTATO (SOLANUM TUBEROSUM). A Radiation-Induced Dominant Mutation for Leaf Shape. Harten, A. M. V.; Bouter, H.; Schut, B. (Institut voor Plankenzieklekundig Onderzoek, Wageningen, Netherlands). Radiat. Bot.; 13: No. 5, 287-292(Nov 1973).

X-irradiation of tuber-eye-pieces of the potato cultivar Burmania (B-173) has resulted in a plant with aberrant leaves. The individual has been designated as 'ivy leaf' (il) and subjected to further investigations for a period of ten years. The 'ivy leaf' is dominant without any pleiotropic effects. The ivy leaf character is believed to be present in each of the three histogenic layers and their derivatives. If there is no chromatid assortment ($\alpha = 0$), 5 complementary genes are needed to explain the observed deviations from simple 3:1 and 1:1 ratios. A model has been worked out involving 4 duplex genes and 1 simplex. The latter gene is responsible for the il-mutant. Another model explains the deviations for the case where α is very high, viz. 0.24. Here one factor suffices. Results obtained from irradiating ivy-leaf plants did not contradict the hypothesis of a dominant mutation for ivy leaf. (auth)

18585 INFLUENCE OF GAMMA RAYS ON CELL DIVISION IN THE SEED ROOTS OF IRRADIATED DRY SEEDS OF VINCA ROSEA L. Sudhakaran, I. V. (Inst. of Science, Bombay). Cytologia (Tokyo); 37: No. 3, 445-456(Sep 1972).

The dry seeds of Vinca rosea L. were irradiated using different doses of gamma rays. The germinanting seeds exhibit delay in the time of germination and reduction in the percentage of germination. A decrease in the rate of increase in the length of the seed roots with increasing dose of gamma rays is also observed. The mitotic abnormalities such as stickiness and clumping of the chromosomes, sticky bridges, and structural changes followed by the bridges and fragments are quite frequently met with in the dividing cells in the present plants. These are relatively the same as the usual characters observed in the actively dividing irradiated cells of root tip in other plants by previous workers. It is to be noted that in the present plant the cells of the root tips are not directly exposed to radiation and these cells are formed later in the root tips during germination of the irradiated seeds and it is quite likely that any metabolic imbalance can be induced in the cells. Thus these abnormalities of chromosomes during cell division cannot probably be attributed only to the direct effect of irradiation on the chromosomes but it is likely that these irregularities and others leading to mitotic delay and inhibition of mitosis are due to the formation of mitotic poison through the breakdown of micro- and macromolecules in the cytoplasm in the dividing cells during the germination of the irradiated seeds. (auth)

18586 DEPENDENCE OF RADIATION SENSITIVITY ON OXYGEN TENSION IN OEDOGONIUM. I. Extra- and Intracellular Oxygen. Howard, A. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Radiat. Bot.; 13: No. 5, 293-296(Nov 1973).

Vegetative cells of the green alga Oedogonium cardiacum were x-irradiated and tested for clonogenic activity. During irradiation, the O_2 tension in the cells was varied using two methods: (1) equilibrating the surrounding water with bubbles of N_2 containing known concentrations of O_2; (2) reducing external O_2 to near-zero concentration by $N_2 + CO_2$ bubbling and permitting the release of O_2 by photo-synthesis within the cells by exposing them to light. The rate of release of O_2 was varied by varying the light intensity. When the radiosensitivity of the cells to loss of clonogenic ability was plotted against O_2 concentration in the surrounding water, the results were fitted by Alper-Howard-Flanders

curve in which M = 3, K = 13μM1^{-1}. Results from the light-intensity experiments were fitted by the same curve when K = 120 lumens/ft^2. (auth)

18587 CORRELATIVE INHIBITION OF ROOT EMERGENCE IN THE GAMMA-IRRADIATED COLEUS LEAF. III. Effects of Auxin on the Radiation-Induced Changes in RNA, RNA Metabolism, and Rooting. Gordon, S. A.; Buess, E. M. (Argonne National Lab., IL). Radiat. Bot.; 13: No. 5, 283-286(Nov 1973).

Post-irradiation treatment with auxin is shown to reverse the depression in levels of RNA and rooting that take place in the petiole base after irradiation of the lamina. Auxin does not reverse the activation of soluble and particulate ribonucleases, but does activate RNA synthesis. These observations are considered to support the concept that the correlative agent is auxin, that the auxin reversal of the irradiation-induced fall in the concentration of RNA derives primarily from an increase in the rate of RNA synthesis, and that sequential falls in the levels of auxin, RNA, and protein provide an explanation of the abscopal inhibition of root emergence. (auth)

18588 EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE GROWTH OF A CRUSTOSE LICHEN, TRAPELIA ORNATA (SOMMERFELT) HERTEL. Snyder, J. M. (Notra Dame Univ., Nelson, B. C.); Platt, R. B. Radiat. Bot.; 13: No. 5, 269-271 (Nov 1973).

The growth of a lichen, Trapelia ornata (Sommerfelt) Hertel, exposed to variations of chronic gamma irradiation stress throughout its life was studied. Tracings of lichen colonies were made on plastic sheets and the average radial growth was determined for each of 52 colonies. Two regression analyses were performed, the first one for maximum annual radial growth and the second for average annual radial growth. A minimum average annual growth rate of 4.02 mm for non-irradiated T. ornata colonies was extrapolated from the first regression analysis while a mean average annual radial growth rate for non-irradiated colonies of 2.58 mm was extrapolated from the second regression line. The general effects of chronic ionizing radiation stress on T. ornata were a decrease in growth rate and a reduction in growth rate variability. (auth)

18589 EFFECT OF POLLEN IRRADIATION ON REPRODUCTIVE CAPACITY, SEEDLING GROWTH, AND VARIATION OF BETULA NIGRA. II. Seedling Growth and Induced Variation. Clausen, K. E. (Forest Service, Rhinelander, WI). Radiat. Bot.; 13: No. 5, 259-268(Nov 1973).

Betula nigra seedlings were raised from controlled crosses made with pollen exposed to 0, 0.5, 1, 2, 4, and 8 kR of gamma radiation. Plants from the 8 kR treatment had poorer survival than those from all other treatments and were 11.5% shorter than the controls. Their leaves also averaged 11.0% smaller than those of the control plants but leaf length/width was unchanged. Dry weights of leaves, stems, and roots after 8 kR were reduced to 79.7, 72.1, and 62.6%, respectively, of those of the controls. Seedlings from this treatment also had the greatest shoot/root ratio. The 1 kR exposure appeared to have a stimulating effect on plant height, leaf size, and dry matter accumulation, but these increases were not statistically significant. Pollen irradiation had a pronounced effect on seedling variation. Plants with abnormal leaves occurred at a frequency at 11.5% in the 8 kR population with asymmetry as the most common type of leaf abnormality. Seedlings with abnormal stems only were rare, whereas plants with various combinations of abnormal leaves and stems increased with the exposure level up to 24.7% after 8 kR. In addition, this treatment level gave rise to 8.2% dwarfs and to 7.7% stunted plants. Thus, the 8 kR exposure resulted in 53.3% aberrant plants, indicating that pollen irradiation should be an effective method of inducing and increasing variation in this species. (auth)

18590 CULTIVATION OF NEUTRON-IRRADIATED ZINNIA ELEGANS SEEDS. Suzaki, T.; Hasegawa, M.; Imai, T.; Kano, M.; Kobayashi, I. (Kinki Univ., Fuse, Japan). Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 9: 33-35(1973). (In Japanese).

Neutron irradiated Zinnia elegans seeds were cultivated and their growth was scientifically observed. Neutron irradiation was carried out in the nuclear reactor UTR-Kinki, whose thermal neutron flux was 1.25×10^8n/cm^2-sec and fast neutron flux was about 3×10^5n/cm^2-sec. From the irradiated seeds, abnormal growth of leaves, stem heights, or lateral branches was observed. And the heavier the irradiation the more remarkable differences between the individual plants can be seen. (auth)

18591 RADIATION EFFECTS ON GROWTH AND CONCENTRATION OF TOTAL ALKALOIDS IN DATURA METEL L. Kaul, B. L.; Singh, C.; Zutshi, U.; Dhar, K. L. (Regional Research Lab., Jammu-Tawi, India). Indian J. Exp. Biol.; 2: No. 2, 133-134(Mar 1973).

Seeds of D. metel were irradiated with 10 to 30 kR of γ rays with a view to studying their effect on the morphological characters and the concentration of total alkaloids. There were several morphological and cytological abnormalities and the concentration of total alkaloids showed a remarkable increase (maximum increase was found at 10 kR). (auth)

18592 RELATION BETWEEN MUTATION YIELD AND CELL LETHALITY OVER A WIDE RANGE OF X-RAY AND FISSION-NEUTRON DOSES IN MAIZE. Smith, H. H.; Rossi, H. H.; Kellerer, A. M. (Brookhaven National Lab., Upton, NY). (1973). vp. (SM-179/28).

From symposium on the effects of neutron irradiation upon cell function; Nuremberg, Germany (22 Oct 1973).

Seeds of a genetic stock of maize (Zea mays L.) heterozygous at the yellow-green locus, Yg_2/yg_2, were used in all experiments. The frequency of yellow-green streaks or sectors in the leaves of seedlings grown from irradiated seeds was used as a measure of radioinduced genetic effects. The seeds containing 6.7% water were irradiated with x rays at a dose rate of 1,658 to 1,845 rad/min or with fission neutrons at a dose rate of 27.5 to 198 rad/min. The irradiated seeds, together with unirradiated controls, were sown immediately in moist soil. When fully mature, the 4th and afterwards the 5th leaf was harvested and scored for frequency of yellow-green sectors. An attempt was made to relate the results obtained to microdosimetric data for x rays and neutrons. (GE)

18593 RELATIVE CYTOGENETIC EFFECTIVENESS OF 28 GeV PROTONS. Smith, H. H.; Woodley, R. G.; Maschke, A.; Combatti, N. C.; McNulty, P. J. (Brookhaven National Lab., Upton, NY). Radiat. Res.; 57: No. 1, 59-66(Jan 1974).

Maize seeds of a genetic stock heterozygous for the yellow-green alleles Yg_2/yg_2 were irradiated with 28-GeV protons from the Alternating Gradient Synchrotron at Brookhaven National Laboratory. Plants were scored for yg_2 sectors on two seedling leaves. The average RBE obtained relative to 250 kVp x-rays was 4.4. Since the 28 GeV protons and the fast secondaries produced in nuclear interactions have low values of LET, the higher efficiency was attributed to the more densely ionizing tracks that result from nuclear recoil and deexcitation. (auth)

Radiation Effects on Animals

Refer also to abstracts 18383 and 20531.

Man

Refer also to abstracts 18104 and 18346.

18594 (ANL/ES-26(Pt.1)) ARGONNE RADIOLOGICAL IMPACT PROGRAM (ARIP). Part I. Carcinogenic Hazard from Low-Level, Low-Rate Radiation. Frigerio, N. A.; Eckerman, K. F.; Stowe, R. S. (Argonne National Lab., Ill. (USA)). Sep 1973. Contract W-31-109-eng-38. 36p. Dep. NTIS $4.00.

The entire Argonne Radiological Impact Program is briefly outlined, and part of the program dealing with radiation hazards from nuclear power plants is discussed in detail. Various models and predictions of carcinogenic hazard are examined and compared with actual experience in U. S. and foreign populations. All of the models predict a significant increment in malignant mortality with increasing background. Observation of the actual populations at risk shows not only no increment, but an actual decrement, so that these predictions are left quite without observational support. It is concluded that extrapolation of high-rate and usually high dose-level studies to low rates and low levels is probably invalid, and that radiation at such levels and rates does not constitute an environmental carcinogen of significance. (auth)

18595 SMALL-INTESTINAL INJURY IN WOMEN WHO HAVE HAD PELVIC RADIOTHERAPY. Newman, A.; Katsaris, J.; Blendis, L. M.; Charlesworth, M.; Walter, L. H. (Medical Research Council, London). Lancet; No. 7844, 1471-1473(29 Dec 1973).

Seventeen women who had radiotherapy for pelvic malignancy were studied. Twelve of them noted a permanent change in their bowel habit, ranging from abandonment of the use of laxatives to frequent bouts of diarrhea necessitating a change in life-style. Sixteen of 17 patients had abnormal cholyl-glycine-1-[^{14}C] breath tests, including all 12 with symptoms. Eight of the 11 small-bowel x rays were abnormal, but only 1 of 13 rectal biopsies showed changes of inflammation and another showed vascular thickening, which is regarded as characteristic of radiation damage to the

gut. No subject had noted blood in her stools. It is concluded that the alteration in stool habit and the interruption of enterohepatic circulation are caused by radiation injury to the small bowel and that such injury is an almost invariable accompaniment to all forms of pelvic radiotherapy. (auth)

18596 RADIATION PROTECTION TESTING OF MEDICAL X-RAY INSTALLATIONS BY EXPERTS. Ewen, K. (Gewerbeaufsicht des Landes Nordrhein-Westfallen, Duesseldorf); Pehl, H. Arbeitsschutz (Cologne); No. 4, 173-176(1973). (In German).

In order to determine the order of magnitude of the radiation dose during x-ray diagnosis and to reduce the radiation dose itself, apperative, organizational, and structural engineering radiation protective measures have to be taken. This is valid for pre-testing and acceptance testing of x-ray devices and for recurring inspections of operating devices. These tests are discussed with a view to the regulations of the X-Ray Ordinance. (GE)

18597 RECTAL DAMAGE AND RECTAL DOSE IN RADIATION THERAPY OF THE CARCINOMA OF THE CERVIX. Sunayama, Y. (Okayama Univ., Japan). Nippon Sanka Fujinka Gakkai Zasshi; 25: No. 8, 826-834(Aug 1973). (In Japanese).

The damage of the rectum due to radiation therapy using the loading method of the National Institute of Radiological Sciences (T.A.O. method) was studied in 377 patients with cervical cancer of the cervix uteri in the Department of Gynecology and Obstetrics, Okayama University. Eleven items concerning rectal damage were analyzed by computer: during the early stage of rectal damage, the incidence of diarrhea and rectal tenesmus, and the relationship between rectal tenesmus and radiation dose to the rectum were analyzed; and during the late stage of rectal damage, its frequency, age distribution, the relationship between rectal damage and classification by clinical findings, the onset time of hemorrhage from the rectum, the degree of hemmorrhage, the relationship between the grade of hemmorrhage and the rectal dose, the relationship between measurement dose to the rectum and the quantity of internal radiation, the relationship between the frequency of internal radiation and the rectal dose, and the relationship between radiation dose to A point and the rectal dose were analyzed, respectively. The incidence of rectal tenesmus was 38.5%. Frequency and grade of diarrhea were increased by cobalt radiation. The incidence of rectal tenesmus was increased with radiation dose to the rectum. The frequency of rectal hemorrhage was 40.5%, which was slightly high rate. Fistula formation was recognized in 1.3% of cases. Hemorrhage from the rectum appeared in 37.8% in less than 4,000 R, and in 48.3% from 4,001 to 5,000 R. In order to reduce the radiation dose, the method of intrarectal measurement was devised. The largest exposed point was 8.5 ± 1.0 cm from the anus. The difference to the actual measurement value was ± 0.5%. This was almost similar to the actual measurement value. (JA)

18598 SERUM LEVELS OF LUTEINIZING HORMONE (LH) AND FOLLICLE-STIMULATING HORMONE (FSH) IN SUBJECTS ACCIDENTALLY EXPOSED TO ^{192}Ir GAMMA RAYS. Wakabayashi, K. (Gunma Univ., Maebashi, Japan); Isurugi, K.; Tamaoki, B.; Akaboshi, S. J. Radiat. Res.; 14: No. 3, 297-303 (Sep 1973).

Serum levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) were determined by radioimmunoassay in six subjects who were exposed accidentally to ^{192}Ir gamma rays. All subjects showed normal levels of LH and FSH shortly after the irradiation. From 100 to 150 days post-irradiation, however, serum FSH levels increased in subjects who received 12.2 rad or more, a finding in agreement with the decrease in sperm concentration below 10 millions/ml, while in the other two subjects who received 9.8 and 10.9 rad, it remained within normal range. The elevation in serum FSH levels in one of the severely exposed subjects was noted as late as 413 days after the exposure, while the hormone levels in all other cases declined toward normal level. (auth)

18599 FOLLOW-UP STUDY OF SUPERFICIAL RADIOTHERAPY FOR BENIGN DERMATOSES. Recommendations for the Use of X-rays in Dermatology. Rowell, N. R. (Leeds General Infirmary, Eng.). Brit. J. Dermatol.; 88: No. 6, 583-590 (Jun 1973).

One hundred out of 136 patients who had received either 1600 rad or more to the face, 1500 rad or more to the hands, 1600 rad or more to the finger nails, or 1600 rad or more to the feet for benign dermatoses during the years 1930 to 1964 were examined. Four patients had developed basal cell carcinomata of the face and one had developed a squamous cell carcinoma of the hands. Atrophy of the face and keratoses and telangiectasia of the hands occurred more frequently than in controls. It is concluded that superficial radiotherapy is a safe procedure for the treatment of benign dermatoses provided that no more than 1200 rad is given in fractionated doses to any area of skin over a lifetime. Recommendations are put forward to ensure that damage does not result from radiation. (auth)

18600 X-RAY EXPOSURE AND RADIATION PROTECTION IN X-RAY DIAGNOSTICS. Schmidt, T. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Atomkernenergie; 22: No. 2, 129-133 (Oct 1973). (In German).

From joint meeting 1972 of the Deutsche Gesellschaft fuer Biophysik and the Deutsche Gesellschaft fuer Medizinische Physik; Erlangen, Germany (4 Oct 1972).

When applying x-rays in diagnostics, the exposure of patients or the whole population should be as low as possible. There are different ways to reduce the exposure caused by diagnostic means. The most important ones are discussed and the influence of modern techniques concerning dosage is described. If several possibilities for the reduction of the x-ray exposure are not used, the dose rate could tend to surpass more than a hundred times the amount of the absolutely necessary dose. Special attention is given to the gonad dose. The contribution of the different diagnostic exposures to the gonads is described. It can be seen, however, that despite the growing number of diagnostic medical examinations the x-ray exposure is not bound to increase equally if the educational standard of the radiologists and the improvement of the techniques are continuously developed. (auth)

18601 REPAIR ENDONUCLEASE-SENSITIVE SITES IN DAUGHTER DNA OF ULTRAVIOLET-IRRADIATED HUMAN CELLS. Buhl, S. N.; Regan, J. D. (Univ. of Tennessee, Oak Ridge). Nature (London); 246: No. 5434-5435, 484(21 Dec 1973).

Some studies are described using cells from individuals having xeroderma pigmentosum (XP), and defective in excision repair, to demonstrate the appearance of uv lesions in DNA. Details are given of the experimental procedure. Daughter DNA from irradiated and non-irradiated normal human cells contains no repair endonuclease-sensitive sites, which is expected since normal human cells excise and repair most of the pyrimidine dimers formed after uv irradiation. On the other hand DNA synthesized by irradiated XP cells does contain such sites, although their number appears small. Possible reasons for appearance of the repair endonuclease sites are given. (UK)

18602 FRONTIERS OF RADIATION THERAPY AND ONCOLOGY. Volume 8. Radiation Therapy and the Cancer Center. Proceedings of the Eighth Annual West Coast Cancer Symposium, San Francisco, California, September 1972. Vaeth, J. M. (ed.). Baltimore; University Park Press (1973). 199p. (CONF-7209106-).

Twenty-four papers presented by world authorities discuss the concepts, organization, funding, and operation of multidisciplinary cancer centers in which radiation therapy plays an indispensable role. (CH)

18603 CONSEQUENCES OF LONG-TERM EFFECT OF LOW RADIATION DOSES IN URANIUM MINERS AND POSSIBILITIES OF PREVENTIVE DRUGS. Adamek, M.; Roth, K.; Stepankova, M. Oesterr. Z. Erforsch. Bekaempf. Krebskrankheit; 26: 192-200(1971). (In German).

Investigations on miners who had been working for more than 3000 days in uranium mines are reported. Besides the evaluation of laboratory tests, the influence of a polyvitamin preparation, which was administered twice a week, on the overall state of health was observed. Moreover the processes were demonstrated which lead to the exhaustion of the defense and adaptation systems under long-term irradiation. It was shown that the metabolic reactions of the defense systems are essentially supported by the highly effective and safely absorbable (lymphatic-corpuscular) multivitamin preparations. (auth)

18604 KONTSEPTSIYA BIOLOGICHESKOGO RISKA VOZDEISTVIYA IONIZIRUYUSHCHEGO IZLUCHENIYA. (Concept of Biological Risks From the Effects of Ionizing Radiation). Moscow; Atomizdat (1973). 68p. (In Russian).

The biological effects of radiation and its significance for individual parts of the population and for the population as a whole were discussed. The level of risk was examined and the characteristics of different situations were given. Some problems of the acceptability of the level of risk for the population under different conditions were discussed. Attention was given to the problem of single or short-term entry of radionuclides into the human organism and their accumulation in foods in concentrations permissible for a given situation. Problems of the feasibility of protection measures for extreme situations are considered. (tr-auth)

18605 RADIATION INJURIES FROM X RAYS. Preliminary Medical Examinations. Stieve, F. E. (Bundesgesundheitsamt,

Berlin). Arbeitsschutz (Cologne); No. 9, 182-185(1973). (In German).

The effects of ionizing radiation on man and the resulting risks of radiation exposure are described. Necessary precautions with respect to the x-ray ordinance are discussed from the medical point of view. (GE)

18606 HAS IONIZING RADIATION BIOPOSITIVE EFFECTS? Broda, E. (Univ., Vienna). Biol. Unserer Zeit; 3: No. 4, 109-115(1973). (In German).

The question of whether ionizing radiation has a positive effect on living matter is critically examined. In doing this the author closely investigates the application of radioactivity for curing purposes, as well as the use of ionizing radiation for therapeutical purposes, as long as it's not being used for the therapy of cancer. Reports on the stimulating effect of ionizing radiation on useful plants can not be considered as safe. The author therefore suggests to test on simple systems (microorganisms) whether an irradiation has a positive effect on the resistance to poisons, high temperature, or irradiation. (GE)

18607 LYMPHOLOGY USING RADIONUCLIDES. First Edition. zum Winkel, K. Berlin; Hoffmann (1972). 128p. (In German).

The fundamentals, techniques, and results of the current diagnostic and therapeutic measures using radioisotopes in the treatment of affections of the lymphatic system are summarized. The feasibility, advantages, and limits of presently known techniques are outlined. The radiation burden to the patient arising from the application of the various isotopes and techniques, especially the radiation dose to the critical organs, the lymph nodes, is briefly discussed, as well as probably occurring local reactions due to diagnostic measures and possible side-effects as a result of endolymphatic radiotherapy. (GE)

18608 SHORT-TERM EFFECT OF RADIATION ON HUMAN NEOPLASMS. Gray, S. R.; Hahn, I. S.; Cornog, J. L. Jr. (Yale Univ., New Haven). Arch. Pathol.; 97: No. 2, 74-78(Feb 1974).

A comparison of the histological pattern of neoplasms before and after radiation therapy showed nondestructive changes of sufficient magnitude and sufficiently unusual type to cause possible confusion in the pathological interpretation of surgical and autopsy specimens. The histological changes delineated herein demonstrate apparent increases in neoplastic differentiation in the direction of greater histological maturity or shifts from one mature pattern to another. Cases in which the histological changes were purely destructive or in the direction of lesser degrees of differentiation were also encountered. Various theories are considered relating to the role of radiation in the production of these effects. (auth)

18609 EFFECT OF IRRADIATION ON THE GASTROINTESTINAL TRACT. Mitchell, G. W. Jr.; Bardawil, W. A.; Bloedorn, F. G. (Tufts Univ., Boston). Clin. Obstet. Gynecol.; 15: 674-691 (Sep 1972).

Factors to be considered in determining effects of radiation on the morphology of the gastrointestinal tract are dosage, sensitivity of the target organ, and the contents of the gastrointestinal tract. Pathological changes in the various tissues of the gastrointestinal tract following acute and chronic radiation injury are described. Fibrosis, edema, ulcers, and perforations are among these changes. Clinical effects of radiation on the stomach include delayed emptying of the stomach and a depression in the secretion of acid and enzymes. Effects on the small intestine are increased peristalsis and impaired absorption. The colon is more resistant than the small intestine but also shows increased peristalsis and bacterial infection. The treatment of radiation injuries is discussed with regard to diet, the use of tranquilizers, and factors that predispose to the development of radiation sickness. (HLW)

18610 TOWARDS A DOSIMETRIC SYSTEM FOR USE WITH IRIDIUM-192 WIRES IN INTERSTITIAL THERAPY: A SUGGESTED PROCTOCOL FOR PLANNING THE SINGLE PLANE IMPLANT. Wambersie, A. (Univ. Louvain, Belgium); Dutreix, A. Atomkernenergie; 22: No. 2, 134-138(Oct 1973).

The results of a dosimetric study for planning single plane implants of parallel equidistant iridium-192 wires are described (Paris technique). Dose distributions in orthogonal planes have been computed systematically for different arrangements of the wires (number of lines, active length, separation of lines). From these results, the dimensions of the target volumes which can be treated by an application of 2 to 5 coplanar wires are determined. With this aim, 4 rules for the applications are defined and discussed. Diagrams are proposed to suggest the best number of wires to suit the dimension of the volume to be treated. Then, other diagrams set the correct separation between the wires and suggest the reference dose to be chosen, as well as the length of the wires. Two examples are discussed. (GE)

18611 MULTIPLE-FILM TECHNIQUE FOR CONTRAST ENHANCEMENT AND/OR REDUCTION OF PATIENT EXPOSURE. Miller, E. R. (Univ. of California, San Francisco). Radiology; 110: No. 2, 361-364(Feb 1974).

Contrast can be increased by superimposing identical radiographic images, either by combining a radiograph taken with intensifying screens with a photographic duplicate or by exposing two films simultaneously in the beam. Patient exposure can be reduced by creating a low-contrast radiograph with low exposure and enhancing contrast in the image. This technique is most useful in mammography, where patient exposure is high, and in examinations in which contrast is inherently low, such as intravenous cholangiography. (auth)

18612 TREATMENT OF BRAIN ISCHEMIA FOLLOWING ARTERIOGRAPHY. Wise, G.; Fontana, M. E.; Burkholder, J.; Leighton, R.; Sutter, R.; Molnar, W. (Ohio State University Hospitals, Columbus). Radiology; 110: No. 2, 383-390(Feb 1974).

Focal brain ischemia developed in 10 normotensive patients during arteriography without systemic hypotension or cardiac ischemia, arrhythmias, or failure. Eight patients improved when blood pressures were increased with vasopressor drugs. Low-molecular-weight dextran, hyperosmotic agents, or corticosteroid drugs did not lower the blood pressure level needed for preservation of brain function in these patients and were not beneficial in the treatment of four others. Vasopressor drugs were useful in the treatment of five patients with brain ischemia secondary to systemic arterial hypotension who did not have cardiac ischemia, arrhythmias, or failure. Contraindications for vasopressor drug treatment include vascular dissections, myocardial and renal ischemia, left ventricular failure, and subaortic muscular stenosis. (auth)

18613 NORMAL AND NEOPLASTIC TISSUE EFFECTS OF HIGH INTENSITY INTRACAVITARY IRRADIATION: CANCER OF THE CORPUS UTERI. Hilaris, B. S.; Ju, H. W.; Lewis, J. L. Jr.; Homesley, H. D.; Kim, J. H. (Memorial Hospital, New York). Radiology; 110: No. 2, 459-462(Feb 1974).

From fifty-eighth scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (26 Nov 1972).

From July 1967 to May 1971, 42 patients with cancer of the uterine corpus had intravaginal applications by the remote afterloading technique. All applications were performed on an outpatient basis. Analysis of the treatment data suggests that fractionated insertions are necessary when using high intensity sources with dose rates of 50 to 70 rads/min or normal tissue effects become pronounced. An equivalent single dose (ESD) of 2,100 rads is effective in preventing local vaginal recurrences without causing late vaginal reactions, providing it is given in three or more fractions. (auth)

18614 REDUCED RADIATION EXPOSURE IN THE OPERATING ROOM WITH VIDEO DISC RADIOGRAPHY. Zatz, L. M.; Finston, R. A.; Jones, H. H. (Veterans Administration Hospital, Palo Alto, CA). Radiology; 110: No. 2, 475-477(Feb 1974).

The radiation exposure required to produce single television images using a video disc recorder with a mobile image intensifier television system was measured during simulated operative procedures. There was a very significant reduction in exposure as compared to fluoroscopy, yet most of the advantages of fluoroscopy were retained. The authors urge that a video disc reorder be incorporated into all mobile fluoroscopy systems. (auth)

18615 HUMAN TISSUES: CHEMICAL COMPOSITION AND PHOTON DOSIMETRY DATA. Kim, Y. S. (Ohio State Univ., Columbus). Radiat. Res.; 57: No. 1, 38-45(Jan 1974).

Chemical compositions of bone (femur), bone (rib), brain (whole), spinal cord, heart (whole, auricles, right and left ventricles), kidney, liver, lungs, muscle, ovaries, pancreas, spleen, and tongue are given for an average human adult. Photon mass attenuation coefficient μ and mass energy absorption coefficient μ_{en} for these tissues are given for photon energies ranging from 15 keV to 2 MeV. (auth)

18616 EXTERNAL-BEAM TREATMENT PLANNING ON A TIME-SHARING GRAPHICS TERMINAL SYSTEM. Sternick, E. S.; Hughes, M.; Hogan, R.; Goodbue, L. R. (Dartmouth-Hitchcock Medical Center, Hanover, NH). Radiology; 110: No. 2, 467-472 (Feb 1974).

A graphics terminal system was developed to facilitate interaction capabilities during external-beam treatment planning on time-shared computers. Since the design of the system is modular in nature, individual components may be added over time without compromising the objectives of the planning process. Two- and three-dimensional programs, based on well-tested

dose calculation algorithms, are available. The system has been in clinical use for more than a year. (auth)

18617 METHOD FOR POSTMASTECTOMY CHEST WALL DOSIMETRY. Webber, B.; Reinhard, D. (Tufts-New England Medical Center, Boston). Radiology; 110: No. 2, 463-466(Feb 1974).

Postmastectomy chest walls are often irradiated by means of parallel opposed, tangential ^{60}Co fields. The necessary given dose per field to achieve a prescribed tumor dose depends on field size, chest curvature, and field separation. Computer calculations on 50 patients indicate that the given dose is mainly determined by a single parameter, the separation between medial and lateral fields. Over a considerable range, the relationship between given dose and separation is linear. A nomogram was constructed indicating the given dose per field necessary to give 200 rads tumor dose. With this method treatment planning with good dose distribution is simplified. (auth)

18618 PROTON RADIATION THERAPY. Archambeau, J. O.; Bennett, G. W.; Levine, G. S.; Cowen, R.; Akanuma, A. (Nassau County Medical Center, East Meadow, NY). Radiology; 110: No. 2, 445-457(Feb 1974).

Physical, technical, radiological, and clinical status of proton therapy is reviewed. Protons produce effects similar to those of x rays, but dose distribution and range make protons more flexible and useful therapeutically. The ability to confine the major fraction of proton absorbed dose to a designated volume allows the decrease of dose to normal tissue or the increase of dose to the cancer. Improved dose distribution is quantified by determining the ratio of normal tissue dose for x rays to that for protons in different treatment plans. Normal tissue integral dose from x-ray therapy is generally 2 to 5 times as high as that anticipated from proton therapy. (auth)

Vertebrates

Refer also to abstracts 18566, 18567, and 18574.

18619 (BNWL-SA-4679) EFFECTS OF INTRACAVITARY IRRADIATION BY CALIFORNIUM-252. Sullivan, M. F.; Beamer, J. L.; Mahony, T. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. Contract AT(45-1)-1830. 17p. (CONF-731050-1; SM-179-29). Dep. NTIS $3.00.

From effects of neutron irradiation upon cell function conference; Munich, F. R. Germany (22 Oct 1973).

Improvements in neutron dosimetry and additional information about the effects of neutrons caused renewed interest in fast neutrons for cancer therapy. The availability of encapsulated ^{252}Cf has introduced the need for data on the response of normal tissues that are at risk during an intracavitary exposure to a ^{252}Cf implant. The anatomical characteristics of the Hanford Miniature Swine make them useful for studies to determine the short- and long-term effects of intracervically implanted ^{226}Ra or ^{252}Cf. Capsules containing 50 mg Ra or 50 μg Cf were inserted in the cervix with a tandem applicator by an after-loading technique. Thermoluminescent dosimeters were attached to organs adjacent to the sources during laparotomy in some animals. The Ra pigs received a fractionated dose calculated as 7,000 to 14,000 rad at a point 2 cm lateral to the source. The Cf swine received between 2,000 and 6,000 rad. Pigs were either killed weekly to determine the early changes or brought to autopsy later because of delayed effects. Others are being killed from 1 to 3 yr after treatment for studies of long-term effects. Acute damage two weeks after 10,500 rad from ^{226}Ra was similar to that caused by 2,800 rad from ^{252}Cf. Damage consisted of a well defined ulcer on the anterior wall of the rectum adjacent to the source location. The ulcer did not heal and persisted into the late period as a chronic radiation ulcer. The urinary bladder, except at the high doses, did not show gross ulceration, but a diffuse erythema occurred in the trigonal or supratrigonal region of the bladder with varying degrees of petechial hemorrhage. These changes provide an acute RBE of greater than six for both the rectum and urinary tract and indications are that the RBE for long-term effects will be larger than for acute radiation injury. (auth)

18620 QUANTITATIVE ASPECTS OF POST-IRRADIATION GRANULOCYTIC RECOVERY. Effect of the Erythropoietic Suppression Subsequent to Hypoxia and Hypertransfusion. Beran, M.; Tribukait, B. (Kungliga Karolinska Mediko-Kirurgiska Institutet, Stockholm). Scand. J. Haematol.; 11: 298-306(1973).

The postirradiation recovery of the myeloid system of normal and hypoxia pretreated mice was studied by quantitative means. In contrast to normal mice, the myeloid system of which recovered with a rise-fall-rise pattern, the hypoxia pretreated irradiated mice showed a sustained recovery with an earlier return of cell numbers to the normal level. Quantitative measurement of the "available pool" of mature neutrophils revealed an enhanced production of neutrophilic granulocytes in mice pretreated with hypoxia. The effect of erythropoietic suppression, which occurs in these mice after cessation of hypoxia, on the myeloid recovery was also studied in mice made polycythaemic by hypertransfusion. The suppression of erythropoiesis per se seems not to be entirely responsible for the improved recovery of the myeloid system. The possible nature of the described changes in the myeloid recovery and their role with regard to the improved survival of posthypoxic mice are discussed. (auth)

18621 EFFECT OF SUBLETHAL X-RAY DOSES ON THE FLUORESCENCE OF LEUKOCYTE NUCLEI IN EXPERIMENTAL ANIMALS. I. Changes in the Fraction of Leukocytes With Green Fluorescence Due to a Single Whole-Body Irradiation With 25, 50, and 100 r. Kolesar, D. (Komenskeho Univ., Bratislava). Bratislav. Lek. Listy; 59: No. 4, 406-414(Apr 1973).

The application was studied of fluorescence microscopy in estimating the response of the organism to ionizing radiation, namely, in investigating colour changes in the fluorescence of leukocyte nuclei in rats. Three groups of albino rats were exposed to a single whole-body x-irradiation in doses of 25 R, 50 R, and 100 R, respectively. Fluorescence microscopy showed that prior to irradiation, 96 to 100 per cent of leukocyte nuclei in healthy animals had fluoresced bright green. Irradiation resulted in a decrease in green fluorescence. The maximum decrease was found in granulocyte nuclei, this 24 and 72 hours after exposure, depending on the dose. After the dose of 25 R, the maximum decrease amounted to 3.5% 24 hours after exposure, the dose of 50 R resulted in a 7.6% decrease, while in the third group the decrease reached 10.1%. The return to normal was observed after three days following exposure to 25 R and 14 days following exposure to 50 R. In the third group, the return to normal was even. Agranulocytes showed considerably lower deviations in fluorescence changes and could not be made use of in diagnostics or prognosis. The dose of 100 R resulted in a statistically significant decrease in the proportion of the total number of leukocytes. (INIS)

18622 ANALYSIS OF THE 3.5-DAY EFFECT IN CHICKEN EMBRYOS. Doehren, R. (Univ., Mainz). (1973). vp.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, Germany (27 Sep 1973).

Some characteristic radiation damages, the so-called 3.5-day-effect, appear in chicken embryos when irradiated with 300 to 500 rads after the second day of incubation. When analyzing these damages, some sensitive zones of about two microns in diameter were found in the object. This dimension corresponds to the diameter of the nucleus of embryonal cells in chicken embryos and indicates that cell nuclei are damaged as well. (GE)

18623 CELL POPULATION KINETICS AND DESQUAMATION SKIN REACTIONS IN PLUCKED AND UNPLUCKED MOUSE SKIN. II. Irradiated Skin. Hegazy, M. A. H.; Fowler, J. F. (Mount Vernon Hospital, Northwood, Eng.). Cell Tissue Kinet.; 6: No. 6, 587-602(Nov 1973).

The kinetics of cellular proliferation in plucked and unplucked dorsal skin of mice after local x-irradiation are described, in relation to the time course of the gross desquamation reaction in skin of the dorsum and of the foot. Radiation was with 250 kV x rays at a dose rate of 325 rads/min to soft tissue over a range of 0 to 4500 rads. (auth)

18624 PRENATAL SURVIVAL OF MICE IRRADIATED WITH FISSION NEUTRONS OR 300-kVp X RAYS DURING THE PRONUCLEAR-ZYGOTE STAGE: SURVIVAL CURVES, EFFECT OF DOSE FRACTIONATION. Friedberg, W.; Hanneman, G. D.; Faulkner, D. N.; Darden, E. G.; Deal, R. B. (Federal Aviation Administration, Oklahoma City, OK). Int. J. Radiat. Biol.; 24: No. 6, 549-560(Dec 1973).

Mouse embryos were irradiated or sham-irradiated in utero during the pronuclear-zygote stage and examined 16 days later. A simple exponential equation is suggested to approximate the relation between surviving fraction of embryos and absorbed dose up to the highest dose used (20 rads of neutrons, 100 rads of x rays). It is suggested that in the dose-range studied, pronuclear-zygote inactivation was predominantly a single-event process (i.e., embryo death resulted from passage of one ionizing particle) with either radiation, and that the relative biological effectiveness of the neutrons (approximately 4.5) was close to the low-dose limiting value. D_0 was 19 rads for neutrons and 87 rads for x rays. With increasing radiation dose, not only did prenatal mortality increase, but the embryos also died earlier in development. Dose-fractionation experiments suggest that irradiation of the early pronuclear-zygote impeded its progression to a less radiosensitive phase. (auth)

18625 RADIATION PATHOLOGY IN RABBITS FOLLOWING DESTRUCTION OF THE POSTERIOR HYPOTHALAMUS. Arutyunyan, R. K.; Tokhiyan, S. R.; Gasparyan, N. A. (Medical Inst., Erevan). Zh. Eksp. Klin. Med.; 11: No. 4, 26-30(1971). (In Russian).

In studies on 23 rabbits, immediately after 600 R of x radiation was used to destroy the posterior hypothalamus, the brain cortex activity increased, but in 15 days it dropped to normal and then decreased somewhat, finally returning to normal by the 20th day. Indexes determined are tabulated, viz. amplitude of the biocurrent in the frontal and rear regions, amplitude of the expressed potentials, the QRS voltage, and the erythrocyte and leukocyte counts. Changes in the leukocyte formula and the EKG, the more prolonged anemia, and the more strongly expressed changes in the EEG in the experimental animals compared to the controls indicate a more severe form of radiation sickness in rabbits irradiated on the second day after coagulation of the posterior hypothalamus than in the controls. (TTT)

18626 RADIOPROTECTIVE EFFECT OF GLUTATHIONE, CYSTEAMINE, AND AET ON MICE FROM REPEATED EXPOSURES TO X RAYS. Kawasaki, S.; Sakurai, K. (Yamaguchi Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 8, 689-692(Aug 1973). (In Japanese).

Mice of dd strain were exposed repeatedly to 300 R at one week intervals to their death. Pretreatment of glutathione (GSH), cysteamine and aminoethylisothiuronium (AET) showed radioprotective effect from radio-induced killing of animals. GSH was given at 30 min., 3 hours, and 6 hours prior to irradiation and a clear radioprotective effect was observed when the drug was given at 30 min. or 3 hours before irradiation. Drug administration at 6 hours before exposure was not so effective. Post-treatment of these agents showed no effect. GSH of 30 mg demonstrated most effective protection among the doses tested. AET of 3 mg or 6 mg and mercaptoethylamine (MEA) of 2 mg suggested radioprotective effects, and AET of 6 mg was the most effective among the SH compounds tested. (auth)

18627 INFLUENCE OF IMMUNOSUPPRESSION ON THE GROWTH OF TRANSPLANTS OF SPONTANEOUS MAMMARY TUMORS IN MICE. Grutenko, E. V. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Folia Biol. (Prague); 19: No. 6, 414-419(1973).

The following procedures suppressed the growth of syngeneic mammary tumours transplanted to mice infected with the mammary tumour virus: thymectomy at 6 days of age, injection of cyclophosphamide, 300R total-body irradiation, administration of antilymphocyte serum, thymectomy of adults with subsequent 750R irradiation, and administration of syngeneic bone marrow cells. Thymectomy of adult mice with subsequent 750R irradiation and administration of syngeneic bone marrow cells did not suppress the growth of a syngeneic hepatoma induced by a chemical carcinogen. Thymectomy at 6 days of age stimulated the growth of mammary tumours in virus-free mice (C57 BL × C3H)F_1. Evidence is presented supporting the suggestion that the growth of mammary tumour transplants is immunologically enhanced in virus-infected mice. (auth)

18628 SEQUENTIAL STUDY OF PHOSPHATASE ACTIVITY IN BETA-IRRADIATED GUINEA-PIG SKIN AND ITS CORRELATION WITH THE HISTOLOGICAL CHANGES. Chang, L. F.; Tabachnick, J. (Albert Einstein Medical Center, Philadelphia). J. Pathol.; 110: No. 3, 251-258(Jul 1973).

Histochemical studies are reported that were undertaken to detect alterations in hydrolase activity in β-irradiated guinea-pig skin and to correlate the enzyme changes with the histological changes during early and late tissue injury, and repair. No clear-cut increase or decrease in acid phosphatase or appearance of alkaline phosphatase in the epidermal cells were found during the early period. Increased acid phosphatase activity began 10 days post-irradiation when epidermal necrosis had already appeared. The increase in enzyme activity became more marked as cytonecrosis became more advanced. At the same time, an intense alkaline phosphatase reaction made its appearance in the necrotic epidermal layers. Degenerating hair follicles showed an increase in acid phosphatase, whereas sebaceous glands also degenerated, but did so without noticeable change in enzyme reactivity. Regenerating epidermis showed some increase in acid phosphatase especially in the granular layer, but alkaline phosphatase was not demonstrable here, nor in normal epidermis. The enzyme 5'-nucleotidase normally present in the epidermis was absent after regeneration. Dermal fibroblasts responded promptly to irradiation by a transitory appearance of alkaline phosphatase and some increase in acid phosphatase during 24 hr post-irradiation. Later (10 to 17 days) the fibroblasts in the inflammatory or ulcerating regions stained intensely for both acid and alkaline phosphatases. During repair (13 to 22 days), the fibroblasts adjacent to the regenerating epidermis again showed a positive reaction for alkaline phosphatase and a moderate rise in acid phosphatase. These changes are thought to mean that, as might have been predicted, fibroblasts have an important role in skin repair after exposure to β radiation. (UK)

18629 HEMATOPOIETIC STEM CELL AND ITS DIFFERENTIATION. Viktora, I. (Ustav Hematologie a Krevni Transfuze, Prague). Cesk. Fysiol.; 21: No. 5, 431-436(Feb 1973). (In Czech).

A review is presented of current knowledge of the hematopoietic stem cell and its differentiation. Attention is focused on the spleen colony formation in lethally irradiated mice after bone marrow cell application, and various factors are discussed conditioning or facilitating the proliferation of stem cells. (INIS)

18630 ELECTROENCEPHALOGRAPHIC CHANGES IN THE RABBIT DURING AND AFTER FRACTIONATED X IRRADIATION. Minamisawa, T.; Tsuchiya, T.; Eto, H. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 2, 136-143(Jun 1973).

The effects of fractionated x-irradiation on the spontaneous electrical activity in the visual cortex were studied in four adult male rabbits with permanently implanted electrodes. Two of the rabbits received a dose of 300 R and two a dose of 1500 R, fractionated into 50 and 150 R per day administered at semi-weekly intervals. The head, except for the region of brain, was shielded with a lead plate. The electrical activity was averaged. The obtained averaged electroencephalograms were classified into seven waves: σ_2, δ_1, θ, α, β_1, β_2, and β_3 by means of an EEG frequency analyzer. The amplitude of the σ_1, δ_1, θ, α, and β_1 waves of the two animals irradiated with 1,500 R gradually decreased with increasing doses during fractionated x-irradiation. The decreased value remained relatively constant throughout the observation period after the end of exposure. The two animals irradiated with 300 R did not show any definite changes in amplitude during and after fractionated irradiation. The results are discussed in reference to the findings of the previous study using photic stimulation. (auth)

18631 STUDIES ON MALE OFFSPRING OF LATER GENERATIONS OF IRRADIATED FEMALE MICE. Batra, B. K.; Nair, I.; D'Souza, A. V. (Tata Memorial Centre, Bombay). Indian J. Exp. Biol.; 2: No. 2, 83-86(Mar 1973).

C_{57}B1/Icrc female mice at maturity were exposed to single 300 R whole-body x-irradiation. Inbreeding was carried out in the colony. In the 16th generation a mutant with a grey coat colour and high gonadotropin content appeared. This "grey" line, which was inbred, became sterile by the 26th generation (10 generations after it appeared). Unmutated "black" line also showed progressive sterility, but not as severe or sudden as "grey". Morphological and histological observations were made on male gonads of the 20-26th generations of mutant "grey", unmutated "black" and untreated controls. The abnormalities included thickened tunica albuginea, atrophy of seminiferous tubules; and sloughing off of immature germ cells was found in both lines though more in "grey" than "black" line. It is found that the total impress of x-irradiation is of considerable consequence, for, eventually, propagation is hampered, which could lead to the termination of lines. (auth)

18632 STRAIN-SPECIFIC EFFECTS OF CHRONIC PRENATAL IRRADIATION IN MICE. Simeonsson, R. J.; Meier, G. W. (George Peabody Coll., Nashville). Develop. Psychobiol.; 3: No. 3, 197-206(1970).

Female mice of the BALB/c and C57BL/6 strains were exposed to ionizing radiation ^{60}Co at a rate of .89 R/hr for 1.5 days of the gestation period (total dose 320 R). Control animals were sham-irradiated and the offspring produced were tested at 30 or 105 days of age for open-field behavior and avoidance conditioning. The magnitude of the prenatal irradiation effect was found to be both strain and sex specific: the open-field activity of irradiated BALB/c mice of both sexes and irradiated C57BL/6 males was significantly higher than that of control animals; the avoidance conditioning of irradiated BALB/c males was greater than that of any other group. Strain specificity was also seen in the viability and morphology of offspring as well as in maternal reproductivity, suggesting that irradiation may have both direct and maternally-mediated effects on fetal development. (auth)

18633 EFFECT OF X-IRRADIATION ON ESTERASES OF TISSUES OF HOUSE LIZARD, HEMIDACTYLUS LESCHENAULTI DUM. AND PIPR. George, K. C.; Eapen, J. (Bhabha Atomic Research Centre, Bombay). Indian J. Exp. Biol.; 2: No. 2, 76-78(Mar 1973).

Studies on esterase isoenzymes using the polyacrylamide gel disc electrophoresis technique show characteristic patterns in brain, kidneys, liver, and lungs of normal H. leschenaulti. The esterase zymogram patterns of all the tissues except brain, change following x-irradiation. X-irradiation alters the amount of esterases in kidneys and lungs, but not in brain and liver. (auth)

18634 RADIATION INDUCED ABNORMALITIES IN EARLY IN VITRO MOUSE EMBRYOS. Kirkpatrick, J. F. (Cornell Univ., Ithaca, NY). Anat. Rec.; 176: No. 4, 397-403(Aug 1973). (COO-3167-78).

Female mice were superovulated and mated, and the two-cell embryos were collected and cultured in vitro. The embryos were exposed to x-irradiation (0 to 491 rads) during the two-cell stage, before the appearance of the next cleavage plate, placed in new unirradiated culture medium and observed during subsequent development. Morphological abnormalities, which occurred as a result of irradiation, included fragmentation, disintegration, granulation, incomplete cleavage, cleavage cessation, nuclear degeneration and pycnosis and cytoplasmic vacuolization. There was no damage to the zona pellucida. The types of abnormalities indicated an agreement with the results of previous in vivo studies. A distinct correlation existed between morphological abnormalities and embryo death. The greatest number of abnormalities resulted within five hours following irradiation, but increased through 20 hours post-exposure. At doses above 300 rads, the magnitude of damage was greater in the in vitro embryos than that shown in previous in vivo studies. (auth)

18635 TRANSPLANTATION OF ALLOGENEIC BONE MARROW IN CANINE CYCLIC NEUTROPENIA. Dale, D. C. (National Inst. of Allergy and Infectious Diseases, Bethesda, MD); Graw, R. G. Jr. Science; 183: No. 4120, 83-84(11 Jan 1974).

Transplantation of normal bone marrow cells to a gray collie dog with cyclic neutropenia resulted in normal granulocytopoiesis. The finding suggests that cyclic neutropenia occurs because the hematopoietic stem cells are defective. Because of the similarity of human and canine cyclic neutropenia, it also suggests that the human disease may be curable by marrow transplantation. One day before transplantation, the recipient received 1000 rads γ irradiation from opposing ^{60}Co sources at 9 rad/min. (CH)

18636 BACTERIOLOGICAL EVALUATIONS OF SWINE EXPOSED TO LETHAL LEVELS OF GAMMA RADIATION. Eisele, G. R.; West, J. L. (Univ. of Tennessee, Oak Ridge). Contract AT-40-1-GEN-242. J. Anim. Sci.; 37: No. 1, 27-32(1973).

Bacteriological studies were conducted on swine exposed to a total air dose of 700 R at a rate of 1 R or 45 R/min of gamma radiation. Blood, muscle, liver, and mesenteric lymph nodes were cultured 10 days postirradiation and muscle again 5 days postslaughter during which time the carcasses had hung in a cooler. A bacteremic state was not detected in the 1 R/min group nor was there a greater incidence of bacterial isolates from the irradiated carcasses. All animals exposed to 45 R/min developed a bacteremia at least once during the 10-day postirradiation period, but this bacteremia was not consistent within the group. Bacterial isolates from the muscles of irradiated animals at slaughter and 5 days later were consistently higher than isolates from controls. Pathologic changes observed in the tissues at slaughter were similar in both groups of animals but were more extensive in the swine exposed to 45 R/minute. Lesions seen were hemorrhagic in nature and indicated injury to the circulatory system. (auth)

18637 IN VIVO INCORPORATION OF ^{14}C-LABELLED AMINO ACIDS INTO PROTEINS OF PLACENTA AND LIVER OF NORMAL AND X-IRRADIATED MICE. Tarachand, U.; Eapen, J. (Bhabha Atomic Research Centre, Bombay). Indian J. Exp. Biol.; 11: No. 4, 281-284(Jul 1973).

Effect of x irradiation on in vivo incorporation of ^{14}C-labeled DL-leucine, DL-phenylalanine, and glycine into placental and hepatic proteins was studied, using 15-day pregnant mice. Pattern of incorporation of leucine and phenylalanine into maternal liver proteins was similar following irradiation. Effect on glycine incorporation was different. Placental incorporation of all the three amino acids, subsequent to irradiation, was comparable. Starvation per se enhanced incorporation of leucine into hepatic proteins which was further elevated following irradiation. Placental incorporation was reduced by starvation. Subcellular fractions showed disparate changes in leucine incorporation due to irradiation. Acid-soluble pool changed, following irradiation, without significantly affecting incorporation of the precursors into proteins. (auth)

18638 GENETIC EFFECTS OF NEUTRONS IN MAMMALS AND THEIR IMPLICATIONS FOR RISK ASSESSMENT IN MAN. Searle, A. G. (Medical Research Council, Harwell, Eng.). vp. (SM-179/38).

From symposium on the effects of neutron irradiation upon cell function; Nuremberg, Germany (22 Oct 1973).

In the last years, the proliferation of nuclear reactors and other sources of high LET radiation has led to a number of large-scale projects on the genetic effects of fast neutrons in mammals, mainly mice, comparing the RBE of high and low LET radiation for the induction of gene mutations and chromosome aberration. A review of the work done in this field by the author himself and other scientists is given. Results on neutron-induced chromosomal aberrations, especially gains and losses of chromosomes and translocations, were compiled. The only deficiencies analyzed in detail are those at the closely linked d and se loci in the mouse, while much work has been done on the induction of dominant lethal mutations. Many investigations were done on the induction of gene mutations by fission neutrons, showing markedly differing dose-response effects for acute and chronic irradiation. The estimates of the likely magnitude of various types of genetic risk associated with human exposure are till now incomplete in some respects and very tentative in others. The results of the UN and the BEIR Report are presented and discussed. (GE)

18639 RADIATION SURVIVAL AND REGENERATION CHARACTERISTICS OF SPERMATOGENIC STEM CELLS OF MOUSE TESTIS. Withers, H. R.; Hunter, N.; Barkley, H. T. Jr.; Reid, B. O. (Univ. of Texas, Houston). Radiat. Res.; 57: 88-103 (Jan 1974).

Mouse testes were studied histologically 35 or 42 days after irradiation. When doses greater than about 800 rads of γ-rays are given, regeneration of spermatogenic epithelium occurs in discrete foci. It is assumed that a single surviving spermatogenic stem cell can regenerate a spermatogenic focus, and that the absence of spermatogenesis in a tubule signifies the absence of a surviving stem cell in that region of the tubule. The fraction of tubules containing spermatogenic colonies was used as an assay of stem-cell survival. The mean D_0 value of the single-dose survival curve was 180 rads. Survivors of a first dose of 600 rads repair sublethal damage during the first few hours after irradiation. The amount of recovery measured in split-dose studies using intervals of 24 hr to 14 days is less than that measured 4 hr after exposure. This is interpreted as evidence for the existence of phases in the division cycle in which the stem cells are sensitive to radiation and into which a proportion of the first-dose survivors progress. Although surviving stem cells progress through the division cycle, and eventually form a focus of spermatogenesis, regeneration of stem cell numbers was not found in experiments continuing for 14 days after irradiation. The relevance of these characteristics to the development of fractionated-dose radiotherapy is discussed. (auth)

18640 METAPHASE CHROMOSOME ABERRATIONS IN THE CHINESE HAMSTER LIVER IN VIVO AFTER EITHER ACUTE OR FRACTIONATED ^{60}Co IRRADIATION. McKay, L. R. (Purdue Univ., Lafayette, IN); Shaw, S. M.; Brooks, A. L. Radiat. Res.; 57: No. 1, 187-194(Jan 1974).

The frequency, type, and persistence of metaphase chromosome aberrations induced in the liver by single acute or fractionated whole-body ^{60}Co irradiation in young adult (minimum age: 8 weeks) female Chinese hamsters were determined. Partial hepatectomy was used to stimulate the liver into active cellular proliferation at a variety of times after exposure. Minimal or no change in the aberration frequency as seen in metaphase spread preparations was observed up to 36 weeks after a single acute exposure of 400 R. Cumulative exposures of up to 1000 R delivered at a rate of 8 R/min in daily fractions of either 4 or 8 R were correlated with the number of chromosomal aberrations observed per cell. The observed aberration frequency was directly related to cumulative exposure and adequately described by a linear equation of the form $Y = a + bX$, where the coefficients were $a = 0.003$ or 0.029 and $b = 2.62 \times 10^{-4}$ or 2.26×10^{-4} aberrations/cell/R in animals irradiated at 4 or 8 R/day, respectively. A single acute exposure to ^{60}Co was shown to be about three times as effective for aberration production as exposure to daily fractions, which is an indication that chromosome repair may have occurred in the liver cells of animals repeatedly irradiated. (auth)

18641 RELATIVE EFFECTS OF WHOLE-BODY SUBLETHAL DOSES OF 60-MeV PROTONS AND 300-kVp X RAYS ON DISEASE INCIDENCES IN RF MICE. Clapp, N. K.; Darden, E. B. Jr.; Jernigan, M. C. (Oak Ridge National Lab., TN). Radiat. Res.; 57: No. 1, 158-186(Jan 1974).

Over 3100 young-adult female RF/Un mice were given whole-body exposure to 60-MeV protons or 300-kVp x rays (0 to 400 rads) and were observed for life-shortening effects and neoplastic and nonneoplastic diseases. Complete pathological examination was done on all animals, and 81% were examined histologically. Similar dose-response curves were seen for most diseases but, with the exception of ovarian tumor induction, x-rays were

slightly more effective in inducing a specific disease than were protons. For life-shortening, x rays were more effective at all doses (0.34 to 0.80 day's life-shortening per rad) with the greatest difference in effect between x rays and protons found at the two lowest doses, 50 and 100 rads. X rays increased the combined incidences of thymic lymphoma and myeloid leukemia, but these leukemias did not account for all life-shortening at higher doses (100 to 400 rads); the remainder may be related to an increase in ovarian tumors. X rays were more effective than protons in inducing myeloid leukemias at 50 to 200 rads and thymic lymphoma at 300 to 400 rads with no differences at other doses. Maximum incidences were reached with x rays at 300 and 400 rads for thymic lymphoma and at 200 rads for myeloid leukemia while there was no difference in effect between radiations on reticulum cell sarcoma and nonthymic lymphoma frequency. Combined observed incidences of all leukemias were not different from controls and irradiated groups at 50 rads, nor at 100 rads for protons, but increased at higher doses. Lung tumor incidence showed a negative dose-response due to the failure of animals to survive long enough to develop this usually nonfatal disease. Ovarian tumors were increased by all doses of both radiations and this was the only instance where protons were more effective than x rays; maximum response was seen at 100 rads for both radiations. Pituitary gland and harderian gland tumors may have been increased by radiation ($P < 0.10$ and <0.05, respectively), but the effect was not dose dependent. Nonneoplastic diseases showed little effect from radiation. Relative biological effectiveness (RBE) for 60-MeV protons was estimated at 0.63 for life-shortening, and at generally slightly less than 1.0 for all parameters, excluding ovarian tumors. Only thymic lymphoma, myeloid leukemia, and ovarian tumors were significantly increased by radiation, with suggested increases in harderian gland and pituitary gland tumors. Other pathological alterations in incidence and severity of disease would appear to be minimal when compared to nonirradiated populations. (auth)

18642 EFFECTS OF SINGLE-DOSE PARTIAL-BODY X-IRRADIATION ON CELL PROLIFERATION IN THE MOUSE SMALL INTESTINAL EPITHELIUM. Lesher, J.; Lesher, S. (Allegheny General Hospital, Pittsburgh). Radiat. Res.; 57: No. 1, 148-157(Jan 1974).

The effects of partial-body, single-dose, x-irradiation on the cell kinetics of the mouse small intestine have been intensively studied. Irradiation of the intestinal region with the anterior part of the mouse shielded produced changes in the epithelial cells of the small intestine that were similar in character to that observed with whole-body irradiation but were less severe and recovery took place more rapidly. The recovery was related to an increase in the proliferative population and an acceleration of the cell cycle. The increased proliferative population persisted longer in the partially shielded animals. (auth)

18643 DOSE PROTRACTION AND ACUTE RADIATION MORTALITY IN THE CHICKEN: A REAPPRAISAL OF INJURY ACCUMULATION KINETICS. Stearner, S. P.; Christian, E. J. B. (Argonne National Lab., IL). Radiat. Res.; 57: No. 1, 121-131 (Jan 1974).

The kinetics of injury accumulation during a single exposure to ^{60}Co γ rays is described in the adult rooster and 3-wk chicken, and the results compared with those previously reported for the 3-day chick. Single exposure periods vary from 30 to 1440 min, with exposures in the lethal range for early (0 to 2 day) and for later (3 to 30 day) acute mortality. For early mortality, an empirical model based on a constant repair or reversal rate during irradiation describes the dose–time relations. Individual repair rates are assumed to be normally distributed and independent of exposure rate. In addition, there appears to be little influence of age between 3 days and 6 mo. For the later (3 to 30 day) mortality, repair or reversal processes operating during irradiation are time limited as well as rate limited, with an effective period of about 360 min. The effectiveness of dose protraction decreases with age. (auth)

18644 DELAYED BRAIN SWELLING AND FUNCTIONAL DERANGEMENT AFTER X IRRADIATION OF THE RIGHT VISUAL CORTEX IN THE MACACA MULATTA. Caveness, W. F. (National Institutes of Health, Bethesda, MD); Tanaka, A.; Hess, K. H.; Kemper, T. L.; Tso, M. O. M.; Zimmerman, L. E. Radiat. Res.; 57: 104-120(Jan 1974).

Thirteen monkeys with catheter reservoir systems for cerebral spinal fluid pressure measurements were exposed to 3500 rads of x-irradiation at 250 kVp, 30 mA, in a single dose to the right visual cortex. In eight, there was abrupt brain swelling 18 to 36 weeks after irradiation, reflected by cerebral spinal fluid pressure 3 to 4 times baseline, with absence of visual evoked response and behavioral blindness in four, and unilateral visual evoked response depression in the other four. After the intravenous injection of Evans Blue, seven monkeys, sacrificed between 20 and 36 weeks, showed proliferative and degenerative changes in the right occipital lobe which was deeply stained with dye. The swelling extended throughout the right hemisphere with distortion in brain structures. One sacrificed at 52 weeks, after resolution of increased pressure, had a fibrotic, nonstained occipital lesion with atrophic changes in both hemispheres. In five there were less pronounced functional and structural changes. Two nonirradiated controls remained within normal limits. The cause for the delayed brain swelling was a breakdown in the blood brain barrier accompanying the delayed radiation lesion, with extravasation of fluid into brain parenchyma. The impaired function was related to local destruction in the right visual cortex and swelling or compression of the visual pathways by the vasogenic edema. (auth)

18645 LEUKEMIA IN IRRADIATED PARABIOTIC RATS. Warren, S.; Udupa, K. B.; Chute, R. N. (New England Deaconess Hospital, Boston). Radiat. Res.; 57: No. 1, 67-72(Jan 1974).

NEDH rats usually have a low (1%) incidence of leukemia, chiefly myeloid in type. This is slightly increased (5%) by parabiosis, especially in females. A dose of 1000 R of x-radiation to one of the pair lowers the incidence of leukemia, but not to usual spontaneous levels. Leukemia may develop in only one of the parabiont pair, which, due to the intimate relationship of the two, would be unlikely to occur if the disease were virus induced. (auth)

Invertebrates

Refer also to abstracts 18367 and 20532.

18646 SOME EFFECTS OF IRRADIATION ON DELAYED AMPUTATION UPON REGENERATION IN TUBULARIA CROCEA. Ferguson, T. (Delaware State Coll., Dover). Int. J. Radiat. Biol.; 24: No. 4, 421-425(Oct 1973).

Tubularia crocea stems 10 to 15 mm long were cut from colonies and ligated at both ends to prevent regeneration. Observations of unirradiated specimens showed that by 40 hr after cutting all the T. crocea had regenerated. Observation for 7 days after a dose of 150,000 R, showed no regeneration of hydranths. When regeneration was allowed to take place at 22° to 24°C, a dose of 50,000 R delayed the process by about 1 day in specimens cut at 0 and 1 day after irradiation. Nine of the 10 stems cut at 1 day and 5 cut at 2 days after irradiation regenerated. When regeneration took place at 24° to 25°C, it was found that 6 of the 10 stems cut at one day and 2 of those cut at 2 days regenerated. Stems cut immediately after irradiation showed regeneration in 7 out of 10 cases. All controls regenerated, though at the higher temperature many of the controls and irradiated specimens failed to keep their regenerated hydranths, the irradiated stems losing regenerates faster. Some delay was also seen in stems receiving a dose of 5000 R and maintained at 22° to 25°C. Delayed amputation effects were also seen. A 1-day delay after irradiation reduced the number of stems completing regeneration by 10%; 2 days by 40%, and 3 days by 70%. (UK)

18647 EFFECT OF GAMMA IRRADIATION ON FERTILITY AND MATING COMPETITIVENESS OF THE MOSQUITO, CULEX PIPIENS MOLESTUS F. (Diptera:Culicidae). Sonoda, H. (Osaka Prefectural Univ., Sakai). Appl. Entomol. Zool.; 7: No. 3, 103-108(Sep 1972).

To know the effects on emergence, longevity, fertility, and mating competitiveness, 2-day-old male pupae of Culex pipiens molestus were irradiated with various dosages of ^{60}Co gamma rays ranging from 1,000 to 12,000 R. Few effects of the gamma irradiation on both emergence and longevity were noticed. However, high levels of egg-mortality could be produced in males by exposing pupae to irradiation. Exposure to 10,000 R produced 99.1% egg-mortality and a dose of 12,000 R gave a 99.9% egg-mortality. The competitiveness test showed that mating activity of radiosterile males was lower than that of the normal males. (auth)

18648 EFFECT OF CAFFEINE ON A REPAIR SYSTEM IN DROSOPHILA MELANOGASTER. Mendelson, D. (Univ., Leiden). Genen Phaenen; 16: No. 3, (Dec 1973).

Young Drosophila females were treated with caffeine and mated to mature males that had been irradiated with 2000 R of x rays. The frequency of radiation-induced dominant lethals, sex-chromosome loss, and rearrangements in the paternal genome was determined. The results show that treatment of the females with caffeine leads to an increase of the frequency of dominant lethals and sex-chromosome loss, and to a decrease in the frequency of

rearrangements. It is suggested that caffeine acts by partially inhibiting repair processes in the oocytes, which are required for the repair or misrepair of chromosome breaks in mature spermatozoa. (auth)

18649 EFFECTS OF INCREASING DOSAGES OF GAMMA IRRADIATION ON WINGBEAT FREQUENCIES OF DACUS DORSALIS HENDEL MALES AND FEMALES AT DIFFERENT AGE LEVELS. Sharp, J. L. (Univ. of Hawaii, Honolulu). Proc. Hawaii. Entomol. Soc.; 21: No. 2, 257-262(Dec 1972).

Regardless of irradiation dosages, both 1-day-old male and female Dacus dorsalis Hendel recorded the lowest mean wingbeat frequencies followed by increases to day 9. Also, high dosages of gamma irradiation such as 20.0 kilorads (Kr) significantly reduced the wingbeat frequencies of both sexes at ages 1, 3, 5, 9, 17, and 33 days. Finally, the wingbeat frequencies of males were more adversely affected by different dosages of gamma irradiation than were the wingbeat frequencies of females. (auth)

18650 PHOTOREACTIVATION OF THE DROSOPHILA EMBRYONIC CELLS IRRADIATED BY ULTRAVIOLET WITH 254 AND 313 NM WAVE LENGTHS. Levin, V. L.; Kozlova, M. A. (Inst. of Cytology, Leningrad). Tsitologiya; 15: No. 11, 1415-1420(Nov 1973). (In Russian).

The death rate of Drosophila embryos irradiated with 254 nm or 313 nm uv at different stages of development may be reduced by a subsequent exposure to light with wave lengths of 334, 365, 404, or 434 nm. Similar illumination was not effective when used prior to uv irradiation. It can be concluded that it was a direct photoreactivation rather than photoprotection that took place. According to the literature evidence it is not improbable that dimers of pyrimidine bases of DNA may develop in the 313 nm uv-irradiated cells with the help of some sensitizing substances. It should be pointed out, that on the exposure to 313 nm the embryos are capable of photoreactivation at any developmental stage, from the zygote to the blastoderm included, whereas on the exposure to 254 nm photoreactivation may occur only at those stages where the dividing nuclei are seen already on the egg surface. Apparently, the photoproducts produced in cells exposed to different uv wave lengths are not quite the same. (auth)

18651 HISTOPATHOLOGICAL EFFECTS OF GAMMA RADIATION ON TESTES OF THE SPOTTED BOLLWORM OF COTTON, EARIAS INSULANA (LEPIDOPTERA: ARCTIIDAE). Ashraf, M.; Anwar, M.; Siddiqui, Q. H. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Radiat. Res.; 57: No. 1, 80-87(Jan 1974).

Histological structure of pupal testes of the spotted bollworm of cotton, Earias insulana Boisd, and effects of gamma radiation on spermatogenesis are described. Increase in dosage and time between irradiation and fixation increased the degenerative changes in various cells. The spermatogonia were most sensitive to radiation followed by spermatocytes and spermatids. The sperm bundles were broken at higher levels of irradiation, but sperm damage was not microscopically visible. (auth)

18652 LACK OF RADIORESISTANCE IN PLODIA INTERPUNCTELLA (LEPIDOPTERA: PHYCITIDAE) EXPOSED TO SUBLETHAL GAMMA IRRADIATION FOR 30 GENERATIONS. Brower, J. H. (Agricultural Research Service, Savannah). Radiat. Res.; 57: No. 1, 73-79(Jan 1974).

Populations of Plodia interpunctella receiving sublethal doses of irradiation (0.5, 1, 2, and 4 krad) each generation for 30 generations were checked for reproductive capacity and resistance to an acute dose of irradiation. Reproductive capacity was decreased by an ancestral history of irradiation, and the reduction was generally positively correlated with both the size of the dose per generation and the number of ancestral generations treated. Irradiation of selected populations with an acute dose revealed no increase in tolerance, even after 30 generations. In general, the greater the amount of ancestral irradiations, the greater the sensitivity. (auth)

Radionuclide Effects (Internal Source)

18653 INTRACELLULAR IRRADIATION OF HeLa CELLS BY TRITIATED THYMIDINE. I. Lactic Acid Production and Exponential Growth. Engel, P. F.; Binderup, L. (Finseninstitutet, Copenhagen). Int. J. Radiat. Biol.; 24: No. 6, 541-548(Dec 1973).

The production of lactic acid by irradiated and unirradiated HeLa cells, grown as monolayer, was investigated. As long as exponential growth was maintained, the lactic acid production was proportional to the increase in cell number, and the production per hour and per cell was constant. When tritiated thymidine was added to the medium, a significant increase of 23 per cent of the lactic acid production per hour and per cell was found for the highest doses. The findings are discussed with regard to the proposed equations and related to the calculation methods of other workers. (auth)

Man

Refer also to abstract 18604.

18654 (CEA-R-4485) RADIOTOXICOLOGICAL SURVEY OF THE INTERNAL CONTAMINATION BY LABELED THYMIDINE FROM URINARY BAIBA SPECIFIC ACTIVITY: USE OF AN ANALOG MODEL. Geronimi, C.; Jockey, P.; Tellier, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France)). Dec 1973. 55p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

Available information concerning the radiological risk associated with internal contamination by tritium-labeled thymidine (3 HTdR) used as a tracer in patients is reviewed. Dosimetric estimation of the risk is related to the specific activity of B-aminobutyric acid (BAIBA), found in the urine, this molecule appearing to be the specific catabolite of thymidine. In situations where only thymidine is present, tritiated water evolution in urine is sufficient to estimate the risk. An analog model based on a pig experiment was used to estimate human exposure. (CH)

Animals

Refer also to abstract 18383.

18655 PULMONARY NEOPLASMS IN RATS IN CHRONIC INHALATION OF THORIUM DIOXIDE. Likhachev, Yu. P.; Lyarskii, P. P.; Elovskaya, L. T. (Inst. of Labor Hygiene and Occupational Diseases, Moscow). Vop. Onkol.; 19: No. 11, 47-54 (1973). (In Russian).

During chronic experiments with inhalation of the thorium dioxide aerosol as well as its mixture with nonblastomogenic aerosols the data were obtained that made it possible to consider that the development of pulmonary adenoma, epithelial metaplasia and cancer of the lung (adenomatous and squamous cell) is reasonably related to the absorbed radioactive dose. In a total absorbed dose up to 1000 rad preblastomatous changes and benign tumors have developed, whereas in 2700 to 3000 rad multicentric tumors already of a malignant character occur. (auth)

Microorganisms

Refer also to abstract 18673.

Nuclide Kinetics and Toxicology

Refer also to abstract 20490.

Man

18656 (AAEC/E-287) EMERGENCY REFERENCE LEVELS. Cook, J. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The risks (probabilities of subsequently developing cancer) associated with UK and US recommendations on dose limits for specific radiological emergency situations are examined and used as a basis for recommending levels of risk at which consideration should be given to specific countermeasures. These emergency reference levels for risk provide a generalized means of deriving consistent emergency reference levels for dose and other hazard parameters applicable to any radiological emergency situation. (auth)

18657 (CEA-R-4535) STRONTIUM-90 LEVELS IN HUMAN BONES COLLECTED IN 1972. Evolution Since 1963. Jeanmaire, L.; Patti, F.; Gros, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Dec 1973. 21p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Levels of ^{90}Sr, as well as some values for stable strontium, in human bones collected mainly in the Paris area during 1972 are presented. The main trend indicates a decrease of radioactive contamination as compared to the previous year. The levels in

bones according to the different age groups and in food throughout the last decade are included. (auth)

18658 (CONF-730907-16) METABOLIC BALANCES OF ^{210}Pb AND ^{210}Po IN UNEXPOSED MEN. Holtzman, R. B.; Spencer, H.; Ilcewicz, F. H.; Kramer, L. (Argonne National Lab., Ill. (USA)). 1973. 8p. Dep. NTIS $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

The metabolic balances of naturally occurring ^{210}Pb and its decay product ^{210}Po were measured in each of 12 men maintained on a metabolic ward. These nuclides were determined in urine and feces from each subject collected for one month or more. Representative diets, drinking water, and atmospheric levels in the ward were also sampled. The mean overall balances (the difference between diet and excreta) of (−0.235 ± 0.075) pCi ^{210}Pb/day and (−0.337 ± 0.100) pCi ^{210}Po/day show that over the collection period, larger amounts were excreted than taken in the diet. Atmospheric intake accounts for an additional ^{210}Pb intake of 0.07 pCi/day, but it contributes a ^{210}Po intake of only about 0.02 pCi/day. The contribution of cigarette smoke and dietary levels of calcium to the balances is discussed. (auth)

18659 (HW-66172) PLUTONIUM IN PUNCTURE WOUNDS. Vanderbeek, J. W. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 25 Jul 1960. 17p. Dep. NTIS $3.00.

The need for definitive radiation protection guidance in 1960 on the treatment of Pu-contaminated wounds is discussed. Areas in which information was needed are listed. It was decided that, until more information was available on the rate of transfer of Pu from a wound to a critical organ, wounds contaminated with 0.057 μCi or greater should be treated by surgical excision, while those contaminated with 0.0008 μCi or less should be left untreated if their removal would cause disfigurement or the loss of function. (CH)

18660 SIX-DAY STUDY OF THE EFFECT OF 100 μg TRIIODOTHYRONINE/DAY ON THE EARLY THYROIDAL UPTAKE OF RADIOIODINE IN EUTHYROID AND HYPERTHYROID SUBJECTS. Ikkos, D. G.; Singelakis, P.; Gonticas, S. C. (Evangelismos Hospital, Athens). Nucl.-Med.; 12: No. 3, 189-201(Nov 1973).

The effect of the oral administration of 100 μg of triiodothyronine (T_3) daily for six consecutive days on the early (10-min) radioiodine uptake by the thyroid gland was studied in 48 euthyroid subjects and 16 patients with hyperthyroidism by daily measurements of the 10-min ^{132}I uptake. The changes of the ^{132}I uptake of the euthyroid subjects during T_3 administration could be described by the equation: Y = 78e sup(-0.0995t) - 22e sup(-1.155t), where Y = ^{132}I uptake in per cent of the control value and t: time in days. No significant changes of the ^{132}I uptake values of the hyperthyroid subjects were observed. Forty eight hours after the first T_3 dose the ^{132}I uptake values of the euthyroid subjects were lower than those of the hyperthyroid ones in all instances but one. It is suggested that measurements of the early (10-min) ^{132}I uptake 48 or 72 hours after starting T_3 administration provide a very useful and practical criterion for evaluating the results of the T_3 thyroid suppression test, especially since in comparison to the classical one the duration of the test can be shortened to 2 to 3 days, the radiation dose delivered to the gland is radically reduced and the discrimination between suppressors and non-suppressors was found to be far better with the proposed modification than with the classical test. (GE)

18661 CLINICAL APPLICATION OF LUNG SCINTISCANNING WITH $^{197}HgCl_2$. Fujii, T. (Shinshu Univ., Nagano, Japan). Nippon Kyobu Rinsho; 32: No. 9, 649-659(Sep 1973). (In Japanese).

Scintillation scanning with $^{197}HgCl_2$ and ^{131}I-MAA was applied to chest diseases. Perfusion scanning with the later revealed disturbances in pulmonary capillary flow in all the cases of bronchogenic carcinoma, especially in hilar types widespread marked disturbances were proved. But in the lung scintigram with ^{197}Hg, more localized high concentration of ^{197}Hg has been observed correspondingly to the tumor and its metastatic foci in thorax. So the combination of these two methods seems to be very useful. Positive results with $^{197}HgCl_2$-lung scintigram were also obtained in some pleural conditions as carcinomatous, exudative pleurisy, etc, and same results were in the atelectatic areas caused by lung carcinoma. (auth)

18662 PHARMACOKINETIC INVESTIGATION WITH ^{14}C-LABELED PREPARATES. Elekes, I.; Csanyi, E. (Gyogyszerkutato Intezet, Budapest). Izotoptechnika; 16: No. 11, 617-625(Nov 1973). (In Hungarian).

Resorption was determined by measuring the concentration in blood. Distribution of the preparate in serum and erythrocytes, effect of location of labeling on measurement, localization of resorption and control of passage were studied. (auth)

18663 EVALUATION OF URANIUM MINE ATMOSPHERES BY MEASUREMENTS OF THE WORKING LEVEL AND RADON. Holaday, D. A.; Jones, J. H. (NIOSH, Salt Lake City, UT). Radiat. Data Rep.; 14: No. 11, 653-657(Nov 1973).

Using estimates of equilibrium ratios and concentrations of unattached atoms in uranium mines, calculations were performed and results presented of the amount of α energy per liter of air per working level available to be imparted to the various regions of the respiratory tract of miners. It was discovered that the factor that caused the greatest effect on the α energy that could be deposited in the lungs was a change in the unattached fraction of the Rn daughters. If the Rn concentration was used to determine potential exposure, Rn to daughter ratios also had a marked effect on the potential α energy deposition. (auth)

18664 TSH STIMULATION OF ^{32}P INCORPORATION INTO PHOSPHOLIPIDS OF THYROIDS FROM PATIENTS WITH GRAVES' DISEASE. Schneider, P. B. (Beth Israel Hospital, Boston). J. Clin. Endocrinol. Metab.; 38: No. 1, 148-150(Jan 1974).

The effect of TSH on the incorporation of ^{32}P into the phospholipids of thyroid slices from 4 cases of Graves' disease was measured and compared to the response of normal human thyroid tissue. Although there was a small elevation of baseline incorporation in some of the cases, the response to TSH as reflected in total and fractionated lipids was within normal limits. This provides an in vitro demonstration that TSH receptors and probably the whole sequence of phospholipid response are normal in the Graves' disease thyroid. (auth)

Animals

Refer also to abstracts 18367, 18677, and 18743.

18665 (LA-DC-12899) ^{238}Pu INCORPORATED IN FISH LIVING IN WATER CONTAINING $^{238}PuO_2$. Adams, W. H.; Fowler, E. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1970. 8p. Dep. NTIS $3.00.

Goldfish were placed in aquaria containing $^{238}PuO_2$ microspheres. At intervals up to 302 days the fish were analyzed and tables are presented to show alpha activity in the gills, intestine, muscles, bones, and total body. Results are also presented for radioactivity of the aquaria water and for radioactivity of the shell and tissues found in the aquaria after 185 days. (HLW)

18666 (LA-tr-71-68) PRINCIPAL MECHANICAL AND ELECTRICAL PROPERTIES OF AEROSOLS. Applications to Radioprotection. Lasseur, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1970. Translation of CEA-BIB-185. 70p. Dep. NTIS $5.50.

Data on the electrical and mechanical properties of aerosols are reviewed. Aerosol generators and the performance of various types of air samples for aerosol monitoring are discussed. The relation of particle size to the distribution and retention of inhaled radioactive aerosols in the respiratory tract of mammals is discussed briefly. (CH)

18667 COMPARISON OF ^{169}Yb-CITRATE AND OTHER TUMOR-AFFINITIVE RADIOACTIVE SUBSTANCES. Kisada, K.; Suzuki, Y.; Mori, A.; Aburano, T.; Seto, H. (Kanazawa Univ., Japan). Rinsho Kagaku; 19: No. 9, 1118-1122(Sep 1973). (In Japanese).

Tumor affinities of ^{67}Ga-citrate, ^{169}Yb-citrate and ^{57}Co-bleomycin were compared by experimental and clinical cases using scintigraphy. ^{67}Ga-citrate showed the highest positive affinity for tumors, but its false positive was high. ^{67}Ga-citrate showed a good capacity to detect lesions difficult to find in the roentogenogram. The tumor scintigram with ^{57}Co-bleomycin was clear. Bone structure was clearly portrayed and the relation of tumor position was clarified by ^{169}Yb-citrate. ^{169}Yb-citrate is especially useful for observing tumors in soft tissue at the same time as metastatic bone tumors. Exposure dose, half-life, and price of these three substances were also discussed. The half-life of ^{169}Yb-citrate and ^{57}Co-bleomycin was long. The exposure dose of bone by ^{169}Yb-citrate was large. When ^{57}Co-bleomycin is used, it is necessary to consider the treatment of excrement. ^{57}Co-bleomycin was expensive in price, followed by ^{67}Ga-citrate and ^{169}Yb-citrate. As future tumor affinity substances, two radionuclides were mentioned, namely, ^{167}Tm-citrate, which does not have the weak point of the long half life of ^{169}Yb-citrate, and bleomycin labeled by nuclides other than ^{57}Co. (JA)

18668 RADON EXPOSURE EXPERIMENTS ON RATS AND MICE. Doke, T. (Waseda Univ., Tokyo); Oshima, T.; Takahashi, H.; Tajima, E. J. Radiat. Res.; 14: No. 2, 153-168(Jun 1973).

Experimental animals were exposed to about 0.01 Ci radon/ml of chamber air. The concentration of radon was measured by a double screen ionization chamber. The concentration of dust free daughters in the chamber is decreased by radioactive decay, attachment to dust particles and deposition to the chamber wall. To express the rate of decrease, the attachment constant k_p and the deposition constant k_w were introduced in addition to the radioactive decay constant. The values of k_p and k_w were experimentally obtained by using a semiconductor detector installed on the chamber wall. The diffusion constant of daughter atoms estimated from the deposition constant k_w was in good agreement with those obtained by other methods. The absorbed lung doses to rats and mice were 8.0 and 18.9 rads, respectively, when radon was introduced into the test chamber at a level of 0.01 Ci/ml. The retention efficiency of the lung was approximately 2% for rats and mice. (auth)

18669 EFFECTS OF DTPA ON THE EXCRETION AND TISSUE DISTRIBUTION OF ^{144}Ce ADMINISTERED SUBCUTANEOUSLY, INTRAMUSCULARLY, AND INTRAVENOUSLY IN RATS. Takada, K.; Fujita, M. (Japan Atomic Energy Research Inst., Tokai). J. Radiat. Res.; 14: No. 2, 187-197(Jun 1973).

A chelating agent, trisodium calcium salt of diethylenetriaminepentaacetic acid (DTPA), was administered intraperitoneally with a single dose of 1.5 mM (750 mg)/kg body weight to rats 1 hr after subcutaneous, intramuscular, or intravenous injection of $^{144}CeCl_3$. Daily urinary and fecal excretion of ^{144}Ce was determined for 15 days postinjection. Tissue distribution of ^{144}Ce 15 days postinjection was also determined. The DTPA markedly increased the urinary excretion of subcutaneously and intramuscularly injected ^{144}Ce as well as of intravenously injected one, and decreased the contents of ^{144}Ce in all the tissues observed. It was suggested that a prompt DTPA treatment followed by intermittent therapy might be effective for the removal of ^{144}Ce transferred from the contaminated wounds and that in the wounds. (auth)

18670 INTESTINAL ABSORPTION OF ^{45}Ca AND ^{89}Sr AS AFFECTED BY Ca, Sr, AND Mg. Mraz, F. R. (Univ. of Tennessee, Oak Ridge). Contract AT-40-1-GEN-2. Poultry Sci.; 52: No. 3, 1208-1209(May 1973).

The small intestines of White Leghorn cockerels (200 g.) were perfused with 0, 1, 5 or 25 mM Ca, Sr or Mg at a rate of 1 ml/min for 100 min. During 25 to 75 min of perfusion, ^{45}Ca and ^{89}Sr were added. The birds were sacrificed and the radionuclides in the carcasses determined. As little as 1 mM Ca, Sr, or Mg reduced ^{45}Ca and ^{89}Sr absorption. These radionuclides also decreased when the Ca content of the perfusate increased from 1 to 5 mM. No significant differences were observed in their absorption when Sr or Mg were raised from 1 to 25 mM. Ca reduced ^{45}Ca and ^{89}Sr absorption at about the same rate, while Sr and Mg reduced ^{89}Sr more than ^{45}Ca. (auth)

18671 DEUTERIUM OXIDE EFFECT ON TEMPERATURE-DEPENDENT SURVIVAL IN POPULATION OF DROSOPHILA MELANOGASTER. Samis, H. V.; Baird, M. B.; Massie, H. R. (Masonic Medical Research Lab., Utica, NY). Science; 183: No. 4123, 427-428(1 Feb 1974).

A comparison of the mean life-spans for populations of Drosophila melanogaster at 10, 20, 25, and 30°C maintained on media prepared with distilled water and with 50 percent deuterium oxide shows that deuteration decreases longevity at all four temperatures. The magnitude of the difference between the mean survival times of populations maintained on deuterated and nondeuterated media is inversely related to temperature between 10 and 30°C. (auth)

Plants

18672 STUDIES ON ABSORPTION OF ^{32}P, ^{59}Fe, AND ^{45}Ca, BY WATER-MILFOIL (MYRIOPHYLLUM EXALBESCENS FERNALD). DeMarte, J. A.; Hartman, R. T. (Univ. of Pittsburgh, Linesville, PA). Ecology; 55: No. 1, 188-194(Win 1974).

A method was developed for determining uptake and translocation of mineral elements by intact submersed aquatic vascular plants in laboratory and field studies. Autoradiographs and radioactivity measurements provided direct evidence that ^{32}P, ^{59}Fe, and ^{45}Ca were absorbed by the roots of Myriophyllum exalbescens and translocated to the shoot tissues. Similar evidence was obtained for absorption of ^{32}P by the shoots and translocation to the roots. Data from experiments designed to compare the effect of substrate type (sand or muck) and the presence or absence of light showed no significant difference in the amounts of ^{32}P absorbed by roots. Translocation of ^{59}Fe from root to shoot tissues occurred mainly when plants were rooted in muck. ^{45}Ca translocation from roots to shoots was greatest for plants rooted in sand and maintained in the light. Phosphorus-32 was generally distributed throughout Myriophyllum as revealed by autoradiography, with some accumulation occurring at the nodal and budding regions. ^{59}Fe and ^{45}Ca were not translocated as readily but some accumulation of each occurred in the stem. Phosphorus-32 absorbed by the roots of Myriophyllum was translocated to the shoot system and released to the surrounding water. Experimental evidence showed that injury to submersed hydrophytes can result in additional release of phosphate to the water. The rate of release is increased as a result of physical damage to the shoot. This provides an additional pathway for the cycling of phosphorus in freshwater environments. (auth)

Microorganisms

Refer also to abstracts 18225–18227.

18673 ^{90}Sr UPTAKE IN A CHLAMYDOMONAS MARINA STRAIN. Rossi-Torelli, M.; Polese, E.; Del Bianchi, S. (CAMEN, Pisa, Italy). G. Fis. Sanit. Prot. Radiaz.; 16: No. 2, 65-70(1972). (In Italian).

A marine alga strain (Chlamydomonas) was cultivated for 10 days in from 0.4 to 8 mμCi ^{90}Sr, after which cell density and radioactivity levels were determined. At concentrations of up to 2 mμCi/ml, cell population growth was similar to that observed in the controls. As values were increased, there was a gradual change in morphology, color, and transparency, until the capacity for development was entirely lost. There was a linear relationship between culture and cell isotope concentration. The calculated angular coefficient coincided with the concentration factor deduced from the experimental data. This factor was constant in the ranged 0.4-2 mμCi/ml, after which it lost its validity. (auth)

New Tracer Techniques

Refer also to abstract 18660.

18674 (IEA-290) EVALUATION OF RADIOIMMUNOASSAY METHOD IN THE DETERMINATION OF THE GROWTH HORMONE IN HUMAN PLASMA. Higa, O. Z.; Souza, I. T. deT.; Wajchenberg, B. L.; Pinto, H.; Pieroni, R. R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1973. 37p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $4.00.

A method is described for the radioimmunoassay of human growth hormone (HGH) in plasma. Statistical analysis indicated that the method has specificity, excellent precision, and accuracy allowing clear discrimination between HGH concentrations in the low and high ranges. (CH)

18675 (STI/PUB-315) MEDICAL RADIOISOTOPE SCINTIGRAPHY 1972. Volume II. Proceedings Series. Proceedings of a Symposium Held in Monte Carlo, October 23–28, 1972. (International Atomic Energy Agency, Vienna (Austria)). Oct 1973. 776p. (In Several Languages). (CONF-721017-P2). $28.00.

Separate abstracts were prepared for the 55 papers presented at this symposium. (CH)

For abstracts of individual papers see: 18682–18736.

18676 USE OF ^{125}I IN FINGERPRINTING RNA. Dube, S. K. (Max-Planck-Institut fuer Experimentelle Medizin, Goettingen, Ger.). Nature (London); 246: No. 5434-5435, 483(21 Dec 1973).

It is stated to be often difficult to obtain highly radioactive in vivo ^{32}P-labeled RNAs from higher organisms for fingerprinting. In such cases, however, in vitro labeling methods can be useful. The method described is based on the fact that iodine has a high specificity for cytosine under certain conditions and that iodine isotopes are easily detectable by autoradiography. Some studies using E. coli formyl-methionine tRNA of known sequence are described, to test suitability of the method for fingerprinting RNAs. A fingerprint of pmol amounts of RNA was obtainable within 2 days, and the results demonstrated the usefulness of ^{125}I for fingerprinting RNAs. The method is especially attractive because of its specificity, simplicity, speed, and sensitivity, and since a fingerprint of a cold RNA can easily be obtained it is a very useful procedure for studying homologies between closely related RNAs from different species, cell types, and RNA tumor viruses. Some examples are described. (UK)

18677 RADIOPHARMACOLOGICAL STUDIES ON THE CADMIUM POISONING. Ogawa, E.; Suzuki, S.; Tsuzuki, H. (Gunma Univ., Maebashi, Japan). Jap. J. Pharmacol.; 22: No. 3, 275-281(Jun 1972).

Cadmium-115m-chloride was intraperitoneally administered to mice, and retention and distribution investigated. Various drugs were also examined for ^{115m}Cd- eliminating effect. Results are as follows: The daily decrement curve of the whole-body radioactivity represents the sum of two exponential functions. The excretion of ^{115m}Cd was greater in feces and less in urine. The excretion continued for 5 days, after which it was hardly seen. Until 6 hr, ^{115m}Cd concentration was the highest in the liver, followed by the pancreas, kidney, spleen, testis, bone, and blood in the descending order. In the 24-hr value, the kidney exceeded the pancreas. The subcellular distribution of ^{115m}Cd in the liver and kidney 1 hr and 18 days after i.p. administration was greater in the supernatant fraction in both male and female mice than the other fractions. In 3 day experiments, these results show that the drugs which are effective on eliminating ^{115m}Cd are chelating agents of aminopolycarboxylic acid group such as DTPA, BADE and EDTA, and BAL, however even the most effective, DTPA, failed to exert an eliminating effect when given later than 24 hr following ^{115m}Cd administration. Monothiol compounds such as glutathione, 2-mercaptopropionyl glycine, L-cysteine, L-cysteinylglycine, mercaptoacetic acid, and penicillamine were often found to increase ^{115m}Cd concentration in the kidney and testes. When stable $CdCl_2$ was added as a carrier, the whole-body retention of ^{115m}Cd decreased, and ^{115m}Cd uptake by the testes also diminished. The addition of $HgCl_2$ produced significant decrease in renal uptake of ^{115m}Cd. The elimination of ^{115m}Cd was unaffected by the administration of $ZnSO_4$, $MgSO_4$, mercurial diuretics, furosemide, Na-ferrocyanate, and Na-alginate. (auth)

18678 RAPID RADIOIMMUNOASSAY FOR THE MEASUREMENT OF TRIIODOTHYRONINE IN SERUM WITHOUT EXTRACTION. Hilger, P.; Herrmann, J.; Krueskemper, H. L. (Univ., Duesseldorf). Z. Klin. Chem. Klin. Biochem.; 11: No. 8, 323-325(Aug 1973). (In German).

A new rapid, precise, and highly sensitive method for the determination of triiodothyronine in serum without extraction is described. It is based on the use of a highly specific antibody and 8-anilinonaphthalene-1-sulfonic acid. (auth)

18679 DETERMINATION OF DIGOXIN IN PLASMA BY RADIOIMMUNOASSAY. Falch, D. (Aker Hospital, Oslo). J. Oslo City Hosp.; 23: No. 2, 35-45(Feb 1973).

During a study of the antiserum and the recommended method of a test kit for the determination of digoxin in plasma (Lanoxitest), it was found that the method could be improved by the introduction of a few modifications. The modified method has a sensitivity better than 0.25 ng/ml, a precision within assay of 6.3%, between assay 8.7%, and a recovery of 93 to 103%. In a group of 128 patients on a maintenance dosage of digoxin, 107 (84%) had plasma values below 2.50 ng/ml. The mean plasma value of eight digoxin intoxicated patients was 3.22 ng/ml. (auth)

18680 SEQUENTIAL LUNG, LIVER, AND BONE SCANS FOLLOWING A SINGLE INJECTION OF ONE RADIOPHARMACEUTICAL. Chaudhuri, T. K.; Christie, J. H. (Iowa Univ., Iowa City). Int. J. Nucl. Med. Biol.; 1: No. 2, 106-109(Nov 1973).

The behavior of intravenously injected ^{87m}Sr-labeled strontium-calcium-phosphate complex in dogs and rabbits is described. The particles passed through stages of macroaggregates, colloids, and finally free ions. A possible biological and biophysical explanation was attempted. (auth)

18681 TUMOR SCINTIGRAPHIC INVESTIGATIONS WITH ^{169}Yb-CITRATE. Pal, I. (MTA Izotop Intezete, Budapest); Karika, Z.; Tarjan, G.; Fuezy, M. Izotoptechnika; 16: No. 11, 626-628(Nov 1973). (In Hungarian).

The ^{169}Yb citrate complex of the Institute of Isotopes of the Hungarian Academy of Sciences seems to be applicable to the scintigraphy of soft parts tumors and the skeleton. (auth)

18682 NEW APPLICATIONS OF RADIOPHARMACEUTICALS LABELED WITH GENERATOR-PRODUCED RADIONUCLIDES. Touya, J. J. (Hospital Maciel, Montevideo). pp 3-25 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Recent advances in the scintigraphic applications of radiopharmaceuticals labeled with generator-produced radionuclides are reviewed. Among such radionuclides currently available the most widely used are ^{99m}Tc and ^{113m}In. Radiopharmaceuticals labeled with these radionuclides that have been brought into routine use in recent years include ^{99m}Tc-labeled human serum albumin, now an important agent for the study of the dynamics of the cerebrospinal fluid, chelates, colloids and microspheres labeled with either ^{99m}Tc or ^{113m}In, now widely used for the study of reticuloendothelial and other functions, and ^{99m}Tc-labeled red cells, now suitable for blood pool scintigraphy. Preparations of ^{99m}Tc-polyphosphate show great promise for bone scintigraphy. As for new scintigraphic procedures with such radiopharmaceuticals, these fall into two main groups. In the first are procedures for the study of organ function in addition to morphology. These are exemplified by the use of ^{99m}Tc for the study of salivary gland function and the evaluation of obstructive and other sialopathies. In the second are procedures for the identification of pathological processes in which different radiopharmaceuticals are used to demonstrate the distribution of functional tissue and that of the circulating blood pool in the organ. These are exemplified by procedures used for kidney scintigraphy in which ^{203}Hg-Neohydrin is used to demonstrate the functional tissue and ^{113m}In-transferrin the blood pool, and other for liver scintigraphy in which both ^{75}Se-selenomethionine and ^{113m}In-colloid are used to demonstrate the functional tissue and again ^{113m}In-transferrin the blood pool. Results of procedures used for bone marrow scintigraphy, in which ^{113m}In-transferrin is used to demonstrate the erythropoietic tissue and ^{113m}In-colloid the reticuloendothelial tissue, are also presented. (auth)

18683 CLINICAL SIGNIFICANCE OF THE LIVER AND SPLEEN UPTAKE OF COLLOIDAL TECHNETIUM-99m. Jasinski, W. K.; Mikolajkow, A. (Inst. of Oncology, Warsaw). pp 29-44 of Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The clinical importance and diagnostic significance of the relative uptake of colloidal ^{99m}Tc by the liver and spleen are discussed. One hundred consecutive liver scans (anterior photorecordings) from the 1970/71 clinical material were reviewed and interpreted, irrespective of the final diagnosis or any other clinical information. Scintigraphy was performed 30 min after intravenous injection of 2 mCi of colloidal ^{99m}Tc in the form of the sulphur colloid. The size of the liver was determined in terms of its maximum width and height in centimeters and the size of the spleen from its maximum height, also in centimeters. The relative uptakes by the liver and the spleen, as well as the absence or presence of metastases, were assessed arbitrarily by simple inspection. The scans were divided in three groups: prevailing uptake in the liver, equal uptake in both organs, and prevailing uptake in the spleen. Mean dimensions were calculated for each group. Subsequently, all cases were regrouped according to the final diagnosis, all cases being proven histologically, and the data correlated with the presence or absence of metastases, the presence of anemia, and the state of development of the disease. While the results indicate tendencies only, they point to a more frequent occurrence of larger organs, especially the spleen, in cases of systemic malignancies and those in which there is a predominant spleen uptake of the colloid. Spleen uptake correlates well with the clinical course of Hodgkin's disease. (auth)

18684 COMPARISON BETWEEN TOMOGRAPHY AND CONVENTIONAL SCINTIGRAPHY OF THE LIVER WITH A SCINTILLATION CAMERA. Lindberg, R. S.; Larsson, G. A. B.; Roos, B. O. (Sahlgren Hospital, Goteborg). pp 45-54 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A gamma tomocamera system represents a further refinement of instrumentation for scintigraphy. The clinical value of this equipment in liver scintigraphy was compared with standard liver scintigraphy procedure with a scintillation camera. In a study of 50 patients with suspected liver disease in which ^{99m}Tc sulphur colloid was used it was found that tomography did not contribute any further useful diagnostic information. The technical merits of both methods are discussed. (auth)

18685 DIAGNOSTIC VALUE OF SCANNING IN LIVER DISEASES. Teymoorian, G. A.; Rashed-Mohassel, M. A. (Teheran Medical School). pp 55-64 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Liver scanning is a simple and safe technique and has become indispensable for the diagnosis of hepatic disease. A review of experience in performing liver scans with ^{131}I-Rose Bengal on 1700 patients is presented, the results of each scan being correlated with the final diagnosis on the patient. The normal variations in the shape, size, and position of the liver scan as seen in 150 normal cases are described. The value of scanning in the diagnosis of diffuse parenchymal hepatic disease such as cirrhosis or hepatitis and in the detection of focal hepatic lesions such as metastases, cysts and abscesses is discussed. The need in diffuse parenchymal disease for confirmation of the presumptive diagnosis by biopsy is emphasized. Mention is made of the use of liver scanning with ^{131}I-Rose Bengal for the evaluation of biliary patency and of combined liver-lung scanning for the detection of sub-phrenic abscesses. Common causes of error in liver scanning are discussed. (auth)

18686 PERUMBILICAL SCANNING OF THE LIVER IN CASES OF MANSONIAN SCHISTOSOMIASIS. da Rocha, A. F. G. (Commission National de l'Energie Nucleaire, Rio de Janeiro). pp 65-73 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-215; CONF-721017-P2.

Mansonian schistosomiasis produces severe lesions in the liver and spleen, mainly due to the eggs of the flukes which are carried through the veins of the portal system and deposited in the liver, causing portal hypertension. The disease affects some ten million Brazilians and represents a serious public health problem. One of the methods proposed for the treatment of schistosomiasis is to filter the parasites in the portal blood by means of extra-corporeal circulation with catheterization of the umbilical vein. This procedure has also been used to inject macro-aggregates of ^{131}I-labeled human serum albumin direct into the portal vein for evaluation of the extent of the lesions. In normal cases the tracer proceeds no further than the liver, but when there are portal-caval shunts the radioactivity passes through the hepatic capillary bed and continues as far as the lungs. The amount of radioactivity in the lungs and the quality of the scintigraphic image that they yield depend on the size of the shunts. (auth)

18687 USE OF RADIOACTIVE TOLUIDINE BLUE FOR CHOLESCINTIGRAPHY. Czerniak, P.; Boruchowsky, S.; Yarshova, A.; Malchi, M. (Tel Aviv Univ., Israel). pp 75-95 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-215; CONF-721017-P2.

The use of ^{131}I-labeled toluidine blue (RTB) as a radiopharmaceutical for morphological and functional studies of the biliary system is reported. A simple method for the preparation of RTB labeled with radioiodine is described; the results of radiochromatographic tests confirm the purity of the product. The results of experimental studies of the distribution and excretion of RTB in rabbits and dogs, including radiochromatographic studies of its metabolism, are presented. These show that the radiopharmaceutical is very rapidly extracted from the circulating blood by the liver and excreted in the bile. It is also extracted by the kidneys and excreted in the urine. Its excretion in the bile makes RTB a suitable agent for scintigraphic visualization of the gall-bladder and determination of the patency of the extrahepatic bile ducts. A summary of results obtained in studies on 140 patients with various conditions illustrating its use for this purpose is given and results obtained in a number of individual cases are presented in detail. Patients were subjected to sequential scintigraphy after the intravenous injection of 2 to 3 μCi/RTB kg body weight. In addition the circulating blood radioactivity, as well as the radioactivity excreted in the urine, the faeces and, when possible, the bile, were measured. An analysis of the data from these radioactivity measurements suggests the possibility of a combined test for the differential diagnosis between intrahepatic and extrahepatic jaundice. The rapid excretion of RTB in the bile is probably due to the fact that in its molecular structure it is more like natural bilirubin than are other radiopharmaceuticals used for the study of the biliary system. (auth)

18688 DATA PROCESSING IN LIVER SCINTIGRAPHY. Snaider, J.; Erjavec, M.; Kernel, G. (Univ. of Ljubljana, Yugoslavia). pp 97-108 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-215; CONF-721017-P2.

Two different approaches for detection of liver tumors by radionuclide scintigraphy are presented. A digital computer method for evaluation of liver scan data is described. In the first step of data processing the liver scan area is defined. In particular, it is necessary to distinguish between the radioactivities recorded over the liver and over the adjacent spleen. The amount of spleen radioactivity varies depending on the particle-size of the tracer and on some biological factors. The problem of separation of these two organs is rather complex since their shapes, sizes, and relative position vary from case to case. The result of the separation procedure is given by the method presented in terms of matrix elements forming a border-line which divides the areas representing the liver and spleen. The purpose of this separation is twofold. It isolates the liver scan area from the spleen area, irrespective of the tracer material used, and it permits a simultaneous study of the liver and spleen. Once the separation curve is obtained, the liver and spleen contours are determined, and several parameters are calculated. A liver pattern function is defined and its usefulness for automatic detection of liver tumors is tested. A dual tracer technique for positive scanning of liver metastases similar to that for pancreas scanning was also tested. Tumor and liver tissue were labeled simultaneously by means of various tracers and, in addition, liver parenchyma was labeled with radiocolloids. By means of the subtraction technique, normal parts of the liver were suppressed in the record while parts of the liver with a relative prevalence of the first tracer were presented. An additional circuitry suppressed the recording outside the liver area. A positive presentation of gross metastases was obtained in most cases, but digital computer processing of scanning data may be needed in conjunction with this method for early detection of smaller lesions. Results obtained using combinations of ^{113m}In colloid, ^{99m}Tc sulfur colloid, ^{198}Au colloid, ^{113m}In-EDTA, ^{197}Hg chloride, ^{67}Ga citrate, and ^{75}Se-methionine as tracers are reported. (CH)

18689 SPLEEN SCINTIGRAPHY IN CASES OF HEMATOSARCOMA: CONTRIBUTION OF DIGITAL SCINTIGRAPHY TO THE INTERPRETATION OF SPLEEN SCINTIGRAMS. Parmentier, C.; di Paola, R.; Bazin, J. P.; Gerard-Marchant, R.; Gardet, P.; Fragu, P.; Chauvel, P. (Institut Gustave-Roussy, Villejuif, France). pp 109-127 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-215; CONF-721017-P2.

Scintigraphy of the spleen was carried out shortly before splenectomy on 50 patients suffering from hematosarcoma, including 47 with Hodgkin's disease. All the scintigrams were obtained with a conventional moving-head scanner equipped with a collimator for thick organs and a unit for digital storage on magnetic tapes. The technique involved the use of altered red cells labeled with ^{197}Hg-BMHP. In seven cases scintigrams were made successively with ^{99m}Tc and ^{197}Hg. The views were standardized as far as possible. Each view was imaged both in the form of a conventional black and white analogue document and in the form of a digital document processed on a computer. The digital document compiled after the event from information assembled on magnetic tape entailed basically a smoothing operation followed by presentation with a curve tracer to produce a colored isocount diagram. A group of three doctors analyzed the images by a rigorous method of double blind reading which involved separate reading of the analogue and digital documents and as precise a coded description as possible of the anomalies detected. At the same time coded statements were drawn up for each spleen from anatomic-pathological examination of the specimens derived from splenectomy. A study was also made of the correlations between the areas of the isocount zones and the weight of the organ. It was concluded that the difficulties and the subjectivity of scintigram interpretation make it impossible at the present time to apply scintigraphy of the spleen to the classification of Hodgkin's disease. (CH)

18690 DETERMINATION OF ORGAN VOLUME BY SCINTIGRAPHY AND ECHOLAMINOGRAPHY. A Comparative Study. Huelse, R.; Wolf, R.; Fischer, J.; Gamm, H.; Hahn, K. (Univ., Mainz). pp 129-138 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-215; CONF-721017-P2.

The determination of the volume of internal organs has, in the past, been done by röntgenological and scintigraphic methods. The latter methods using $^{99m}TcO_4^-$ or ^{51}Cr-erythrocytes as tracers, were applied to the evaluation of the thyroid, liver, and spleen masses. Because of the importance of knowing the thy-

roid mass in the therapy of this organ with radioiodine and the clinical importance of the detection of splenomegaly, ultrasonic echolaminographic methods were applied to these problems and compared with results using scintigraphic methods. By means of commercial diagnostic ultrasonic equipment, length, depth, and width of each lobe of the thyroids of 21 cadavers were determined and the volumes of the organs were calculated by using different formulae. The results were compared with those obtained by direct determination of organ volume. A highly significant correlation was found between the calculated values based on the ellipsoidal formula and the actual volumes. The comparison of actual measurements and values obtained by scintigraphy in one plane showed good correlation for smaller organs with regard to the length of the thyroid, but poorer correlation with regard to the width of the organ. Determinations of the spleen volume based on scintigraphy in 162 cases undergoing splenectomy showed a highly significant correlation between the calculated values based on scintigraphy and the actual spleen volumes. The length, depth, and width of the spleen in-vivo at different sections of the organ were determined. In 18 cases undergoing splenectomy a direct check of the calculations, based on the ellipsoidal formula, was carried out. A comparison of the results of scintigraphy and echolaminography showed a higher correlation for the results of the latter method. (auth)

18691 STUDY OF THE SALIVARY GLANDS BY SEQUENTIAL SCANNING. The Radiosialogram. Baron, J. M.; Rosen, G. (Central Emek Hospital, Afula, Israel). pp 141-146 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The property of the pertechnetate ion, after intravenous injection, to be taken up by and then discharged from the salivary glands forms the basis of a method for the morphological and functional study of these glands. The method depends on sequential scanning after injection of ^{99m}Tc-pertechnetate. Typically, sequential scans are first carried out in the anterior view during the uptake phase, at 5, 10, and 20 min after injection. These scans give information on the parenchymal function of the glands and demonstrate the extent and location of any parenchymal damage. A few drops of lemon juice are then squeezed into the patient's mouth and a final scan is carried out to demonstrate any interference in the discharge of saliva into the oral cavity. When necessary, lateral scans are also made. Color scanning is particularly useful to demonstrate spatial and temporal changes in concentration of the tracer. Results of studies on 95 patients with a variety of salivary gland abnormalities are tabulated and a few selected abnormal scans are presented. (auth)

18692 PHARMOCODYNAMIC STUDIES OF THE SALIVARY GLANDS WITH A SCINTILLATION CAMERA AND A DATA STORAGE AND PROCESSING SYSTEM. zum Winkel, K.; Schmidt, L.; Ammon, J.; Das, B. K. (Klinikum Westend, Berlin). pp 147-155 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A scintigraphic method for investigations of salivary function in routine clinical practice is described and results obtained by the method in investigations on 305 patients summarized. The method is based on the administration of ^{99m}Tc-pertechnetate followed by stimulation of the glands by carbamoylcholine chloride. Serial scintigrams are recorded by means of a scintillation camera combined with a data storage and processing system permitting the derivation of curves showing the function of individual glands. Characteristic results obtained in subjects with normal salivary function, in patients with acute and chronic inflammation of the salivary glands and stenosis of the salivary ducts, and in patients undergoing radiotherapy involving irradiation of the salivary glands are presented. (auth)

18693 PROBLEMS IN THE INTERPRETATION OF PANCREAS SCINTIGRAMS. Zita, G. (Nuklearmedizinische Gastroenterologie, Vienna); Mueller, H. C.; Zseboek, Z. B.; Martonffy, K.; Gottwald, G. pp 157-165 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Increasing demands for pancreas scintigraphs by clinicians have encouraged nuclear medicine specialists to improve this unsatisfactory technique. Visualization of the pancreas is possible with and without the subtraction of liver radioactivity, but the evaluation of pancreas scintigrams is very difficult. Special attention should be given to the problem of radioactivity in the gastrointestinal tract and correlations between the scintigraphic findings and the presence of such radioactivity. The results of 843 cases showed a relatively good agreement between scintigraphs using ^{198}Au colloid, ^{99m}Tc sulfur colloid, or ^{75}Se-selenomethionine as tracers and the clinical findings. (CH)

18694 TECHNIQUES IN PANCREAS IMAGING. Meckstroth, G. R. (Charity Hospital of Louisiana, New Orleans); Staub, R. T. pp 167-180 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy, Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The precise location of the pancreas is sometimes difficult to define. Because of the constant anatomical relationship of the head of the pancreas within the duodenal loop, display of the duodenum prior to pancreas imaging removes the uncertainty as to the location of the pancreatic head as well as facilitating the position of the patient. Display of the duodenal loop may be achieved by oral administration of 250 μCi of ^{99m}Tc sulphur colloid. Once the target area is defined, the ^{75}Se pancreas study is performed in the conventional manner. Overlap of the duodenal loop by the left lobe of the liver can be quickly appreciated and the patient repositioned for an unobstructed display of the area of interest. Radionuclide imaging of the pancreas is possible with ^{75}Se selenomethionine provided the extra-pancreatic localization of tracer in the liver and small intestine does not interfere with pancreas visualization. Several investigators have indicated significant diagnostic improvement in pancreas imaging by eliminating ^{75}Se selenomethionine localized in the overlying liver with dual radionuclide subtraction techniques. Anatomically constructed liver and pancreas phantoms containing radionuclides ^{75}Se, ^{99m}Tc, and ^{198}Au were evaluated employing a scintillation camera with a 1000-hole, 3-in. collimator and a tape storage unit. All data were processed in a 4096-channel analyzer. Comparison of counts obtained in channels corresponding to liver depths varying from 2.5 to 12 cm for ^{99m}Tc and ^{198}Au demonstrated significant variation in relation to ^{75}Se. Expressed as a ratio, ^{75}Se-^{99m}Tc values varied from 0.1 (liver depth, 2.5 cm) to 2.0 (liver depth, 10 cm) and ^{75}Se-^{198}Au values ranged from 0.3 to 1.3. These variations are significantly emphasized when subtraction of ^{75}Se selenomethionine liver-pancreas images are performed. By using ^{99m}Tc sulphur colloid liver data, a greatly distorted pancreas image was obtained; with ^{198}Au subtraction, distortion of the pancreas was less but still significant. The differences in the ratios may be attributed to statistical fluctuations with relatively low count-rates per channel and differential absorption in an organ that changes in thickness from 2.5 to 12 cm. The data indicated that precision subtraction cannot be performed with these techniques. (auth)

18695 SCINTIGRAPHY OF THE PANCREAS BY DOUBLE ISOTOPIC SUBTRACTION WITH COMPUTER PROCESSING OF THE DATA OBTAINED. Henry, J.; Furehling, J.; Turpin, J.; Verbist, A. (Institut Jules Bordet, Brussels). pp 181-189 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

An original method is described for subtracting with the aid of ^{99m}Tc gastric and intestinal activity of ^{75}Se recorded on the original image, using a computer of medium capacity (12K) for processing the information obtained with a gamma-camera during scintigraphy of the pancreas. The method for subtracting the parasitic ^{75}Se activity in the alimentary tract is used as a complement to the now standard technique of subtracting hepatic activity after imaging of the liver by means of radioactive colloidal gold. A dose of 2 mCi of ^{99m}Tc pertechnetate is administered orally and an image of the filling of the alimentary tract is obtained between recording of the images provided by the other isotopes (^{75}Se and ^{198}Au). For the subtraction a coefficient calculated on the basis of the integrated activities of extrapancreatic superposable surfaces recorded in the ^{75}Se and ^{99m}Tc spectra is used, before subtraction of the image obtained with the aid of ^{198}Au. The following programs are run on the computer: homogenization of the crystal image; smoothing of the recorded data obtained; calculation of the subtraction factors for ^{75}Se minus ^{99m}Tc and ^{75}Se minus ^{198}Au; and lastly a print-out of the results of the final image with numerical representation of the different activity levels. In addition, it was considered important to investigate the extent to which the whole complex of technical procedures must be applied in order to obtain a valid scintigram of

the pancreas. Out of 167 scintigrams a clear image of the pancreas was achieved in 52% of the cases; a direct analogue image from the gamma-camera is adequate in 16% of the cases; in 17% of the cases it is necessary to have a digital image and in 19% it is necessary to apply computer programs to that image. The pancreas is wholly or partly covered by the hepatic image in 48% of the cases. A simple subtraction (^{75}Se minus ^{198}Au) is sufficient in 10% of the cases, the use of computer programs is necessary in 24%, and double subtraction is required in 14%. A large number of scintigrams have been verified by anatomical and pathological means or surgically. In the series of cases considered there were no false negatives but 12% false positives. (auth)

18696 COMPUTERIZED DUAL-ISOTOPE PANCREAS FUNCTION SCINTIGRAPHY WITH A MULTICRYSTAL SCANNER. Hundeshagen, H.; Creutzig, H.; Henskes, D. T.; Geisler, S. (Medizinische Hochschule, Hanover). pp 193-200 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The use of a multicrystal scanner and on-line computer system for the visualization of the pancreas and study of its function by a dual-isotope subtraction technique is described. The method employed involves the injection of ^{75}Se-selenomethionine and the recording of a series of combined pancreas and liver scans followed by the injection of ^{198}Au colloid and the recording of a liver scan, all the scan data being stored within the computer memory. The pancreas and liver scans are then processed by a pancreas subtraction program and the processed pancreas scans presented as teletype print-outs or displayed on a color television monitor. The program also permits the extraction of dynamic functional curves showing the variation of ^{75}Se radioactivity with time in selected regions of interest. The program permits very fast access to the complete diagnostic information and also provides a permanent record of the processed data. The method has been employed in examinations on 1700 patients and an analysis of the results of these examinations in terms of other clinical findings, demonstrating its value for screening purposes, is presented. (auth)

18697 ANGIOSCINTIGRAPHY OF THE PANCREAS AFTER VASOCONSTRICTION. Czembirek, H.; Imhof, H.; Pokieser, H.; Umek, H. (Medizinische Universitaetsklinik, Vienna). pp 201-210 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

In angiography, vasoconstrictive substances are successfully used for improving visualization of the pancreas. The injection of adrenaline before angiography reduces or eliminates the flow of the contrast media into the liver and spleen by constriction of the respective major vessels. The minor vessels, such as the pancreatic arteries, undergo a lesser degree of constriction, a factor that may improve visualization of the pancreatic vessels. Until recently this adrenaline-induced action was only applied in visceral angiography. Its application in angioscintigraphy is now described. In each of 20 patients, after coeliac angiography had been performed by the usual technique, adrenaline was given by way of an intra-arterial catheter. Angiography was then repeated and immediately thereafter an injection of 3 to 5 mCi of ^{99m}Tc microspheres was made by way of the catheter and angioscintigrams obtained. Twenty patients subjected to angioscintigraphy after coeliac angiography, but without the administration of the adrenaline, served as a control group. For evaluation of the results, the pancreas was broken down into the three regions (the head, body and, tail) and the effect of adrenaline on the extent of visualization of the organ in both angiograms and angioscintigrams was evaluated. The head region of the pancreas was visualized satisfactorily in the angioscintigram in 14 cases, the body and tail regions in 9 and 6 cases, respectively. In most cases the quality of the angiogram and that of the angioscintigram were about the same. The factor most frequently observed to impair visualization of the body and tail regions was superimposed radioactivity in the gastric wall, and this in spite of the previous administration of adrenaline. In angioscintigrams of the pancreas without previous administration of adrenaline, radioactivity in the liver and spleen generally proved to be a very disturbing factor; however, when adrenaline was given these influences were eliminated. (auth)

18698 QUANTITATED SCINTIPHOTOS IN PREDICTING EARLY RENAL TRANSPLANT REJECTION. Hayes, M.; Taplin, C. V.; Moore, T. C. (Univ. of California, Los Angeles). pp 211-223 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The management of the kidney transplant recipient patient is aided by successful prediction of early rejection since appropriate changes in immunosuppressive therapy may frequently reverse the setback. Quantitated serial scintiphotos using ^{131}I-hippurate as the tracer were compared with the results of standard methods as indicators of renal status and as predictors of early transplant rejection. Renal studies were performed on 60 renal transplant recipients on a frequent, often daily basis, during the first 14 post-operative days. Studies included sequential renal scintigraphy, renograms, blood urea nitrogen, creatine, urine output, monitoring the blood disappearance rate of hippurate, and occasional radioisotope angiograms. Various quantitative analyses were made of scintiphotos, renograms, and heart clearance curves. Results showed that a 20-min bladder/kidney ratio derived from quantitated sequential hippurate scintiphotos was not only the most sensitive indicator of renal function but in 80% of cases predicted rejection by one to two days before other standard methods or clinical diagnosis by the transplant team. Additional data are presented illustrating how radioisotopic studies may differentiate tubular dysfunction due to ischaemic damage (ATN) from rejection, and also how these studies aid in the classification of the type of rejection (hyperacute rejection associated with performed circulating antibodies versus rejection due to transplant-induced host response). A practical protocol based on 3½ years' experience with the methods described is presented. (auth)

18699 RENAL UPTAKE OF MERCURY DICHLORIDE AS MEASURED BY MEANS OF DIGITAL SCINTIGRAMS OBTAINED WITH A SCINTILLATION CAMERA. Erbsmann, F. (Hospital St. Pierre, Brussels); Schoutens, A.; Paternot, J. pp 225-235 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1972). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The conditions for measuring renal uptake of mercury dichloride ($^{197}HgCl_2$) are discussed. An initial model study showed the importance of selecting a spectrometric threshold situated at the top of the peak and using the geometric mean of two counts from opposite directions to reduce the effect of depth on measurement; it also shows that it is possible to correct the gross activity of a kidney for the contribution made by contralateral kidney diffusion. This correction depends, however, on the depth of the kidneys, the ratio between the activities of the two organs, and the spectrometric window selected. Measurements carried out on patients with the help of a γ camera and $^{197}HgCl_2$ as the tracer entail several methods of delimiting the kidneys: broad delimitation, theoretically desirable and difficult to achieve; narrow delimitation, which can be automated but gives poor results; and the manual method used with contrast representation. The calculation method using the geometrical mean of anterior and posterior measurements has proven practicable in vivo and no longer requires the depth of the kidneys in the body to be determined. (auth)

18700 SEQUENTIAL, REGIONAL, AND QUANTITATIVE EXAMINATION OF THE KIDNEY. Delaloye, B.; Delaloye-Bischof, A. (Univ., Lausanne, Switzerland). pp 237-249 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A method of morphological, functional, and quantitative kidney exploration that is both rigorous and precise was developed using scintiscanning with hippuran labeled with ^{131}I. Radioactivity measurements were carried out with a system comprising an Anger camera, a buffer memory, and a small PDP 8 computer. Analogue documents have been obtained which in a number of pathological situations allowed diagnosis of flexure or stricture before this was possible by any other method. In cases of serious renal insufficiency the renal silhouettes can be imaged. Where there are lateralized or focalized lesions, a procedure was developed that makes it possible to assess the overall function of the organ, to compare it with that of the other kidney, or to examine only the affected area, and allows a check on the effectiveness of a treatment aimed at avoiding serious renal insufficiency over a more or less extended period. In more than 60 diverse cases of nephrological pathology, the validity of the method was verified and its advantages over purely morphological examinations were demonstrated. The information obtained is important above all in cases of malformation, transplantation, localized attack, or extrinsic compression. As regards the measurement of renal

blood flow, difficulties are encountered because of the statistical shortcomings inherent in the weak renal concentration of the tracer in the vascular phase. (auth)

18701 TECHNETIUM-99m-DTPA RENAL STUDY. Atkins, H. L.; Klopper, J. F.; Eckelman, W. C.; Richards, P. (Brookhaven National Lab., Upton, NY). pp 251-262 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A rapidly and simply prepared technetium chelate, ^{99m}Tc-diethylenetriaminepentaacetic acid (^{99m}Tc-DTPA), has been shown to behave as a truly glomerular filtrable agent. The biological properties as well as the physical characteristics of technetium-99m make this a useful agent for diagnostic studies of the kidneys. The possibility of using large administered doses while producing a low radiation dose to the patient results in being able to obtain information not possible with most other renal diagnostic agents. A method of examination which provides information on a number of aspects of renovascular anatomy and physiology is described. Patient studies were carried out with the aid of a gamma camera interfaced with a computer system. After a bolus injection of 15 mCi of ^{99m}Tc-DTPA, sequential images of the kidneys were collected over 10 min at the rate of 8 every 15 sec. Fractional urine collections were made up to 3 to 4 hr and three blood specimens were obtained at 2, 3, and 3½ hr and assayed for radioactivity. From the initial scintiphotos a demonstration of the abdominal aorta and perfusion to both kidneys was obtained. Subsequent scintiphotos provided an excellent demonstration of renal anatomy and indicated the presence of ureteral obstruction. The curves of the time course of radioactivity indicate relative renal blood flow, renal transit time, and abnormalities of renal function. The blood and urine samples were used to calculate glomerular filtration rate. Residual volume after voiding can also be calculated during the procedure if desired. (auth)

18702 SEQUENTIAL RENAL SCINTIGRAPHY BY USING TECHNETIUM-99m-DTPA AND THE ANGER CAMERA. Constantinides, C.; Kostamis, P.; Binopoulos, D.; Paschos, A.; Constantes, J.; Malamos, B. (Univ., Athens). pp 263-273 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

^{99m}Tc-DTPA was found very useful for evaluation of kidney structure and function with rectilineal scanners and the gamma-camera. In some cases when mercurial agents failed to visualize the kidneys, the chelate was superior in defining renal size, shape, and position. Sequential scintigraphic studies with the gamma-camera, after the administration of the chelate, permitted visualization of early uptake, renal structure, and subsequent excretion. In some cases when the diagnosis could not be established with mercurial agents it could be established with the chelate. (auth)

18703 STUDY, BY MEANS OF SCINTIGRAPHY AND PARTIAL RENOGRAPHY USING DPTA-^{169}Yb, OF ISCHAEMIA-INDUCING CHANGES IN ARTERIAL BLOOD FLOW THROUGH THE KIDNEYS: A SERIES OF CASES OF HYPERTENSION. Poeyhoenen, L.; Holli, H. (Hospital Central, Tampere, Finland). pp 275-288 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

To establish which patients had normal renal function, renographic curves were constructed using Hippuran and DTPA-^{169}Yb for each of 50 cases examined. The clearance of Hippuran and of DTPA-^{169}Yb (a method entailing a single injection with two plasma tests) and the uptake of mercury by the kidney were also determined. A series of gamma photographs were taken and segmentary renographic curves were drawn with the object of comparing the results for patients having normal renal function and those suspected of renal ischaemia. The gamma photographs were made with the help of 1 to 2 mCi of DTPA-^{169}Yb every 2 min for 20 min. The renographic curves were constructed at the same time as the photographs were taken, but every minute; three curves were made for the upper polus, three for the lower polus, and three at the level of the renal pelvis, i.e. nine segmentary curves for each kidney. When a change in renal function was observed, intravenous pyelography and angiography were also carried out. An attempt was made to distinguish more clearly the changes due to renal ischaemia, which are more diffuse than the changes due to chronic pyelonephritis. Hydronephrosis was also taken into consideration; in less advanced cases an accumulation of activity was observed in the region of the renal pelvis and on the corresponding segmentary curves, whereas the kidney polus curves were normal. (auth)

18704 RENAL SCINTIGRAPHY USING TECHNETIUM-IRON-GLUCONATE AND THE SCINTILLATION CAMERA. McLaughlin, A. F. (Royal Prince Alfred Hospital, Camperdown, Australia); Morris, J. G.; Crocker, E.; Booth, J. A.; Towson, J. E.; Boyd, R. E.; Robson, J.; Hunt, F. C. pp 289-295 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The application of a new radiopharmaceutical, technetium-99m-iron-gluconate, for the diagnosis of a wide variety of renal conditions is discussed. The advantages of this compound include ease of preparation, stability, and desirable pharmacology exemplified by excellent clinical results in over 100 patients. After intravenous injection, technetium-iron-gluconate fractionates into components which are fairly rapidly excreted in the urine and a component which is retained in the renal cortex. This enables renal perfusion, excretion, and renal parenchymal studies to be obtained using a single radiopharmaceutical. The application of this agent for the study of medical and surgical problems, such as parenchymal space lesions, renal artery stenosis, transplant evaluation, and a range of renal diagnostic problems was examined. The renal specificity of this compound is superior to that of radiological contrast media and renal scintigraphy can readily be performed when renal function is too poor to permit conventional pyelography. (auth)

18705 NEW APPLICATIONS OF RADIOPHARMACEUTICALS LABELED WITH CYCLOTRON-PRODUCED RADIONUCLIDES. Glass, H. I. (Hammersmith Hospital, London). pp 299-324 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

By 1974 at least 14 medical cyclotrons will be in operation in seven countries, as well as five commercially operated cyclotrons. Reference is made to the literature since 1968 on clinical applications of scanning using cyclotron-produced radionuclides. These applications are discussed under four main categories: localization, electrolyte spaces, organ function, and blood flow. It seems likely that significant advances in these areas will be made in the next few years, particularly in the field of labelled organic compounds. A list is included of cyclotron-produced radionuclides of medical interest. (CH)

18706 BONE SCINTIGRAPHY WITH SHORT-LIVED RADIOPHARMACEUTICALS AND COMPUTER ANALYSIS. Dreyer, J.; Georgi, P.; Lorenz, W. J.; Scheer, K. E. (Inst. for Nuclear Medicine, Heidelberg). pp 327-339 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The use of short-lived radionuclides such as ^{18}F or ^{87m}Sr for bone scintigraphy not only allows the administration of larger amounts of radioactivity, with a consequent enhancement in count-rate, but also reduces the radiation exposure of the skeletal system. The results of experimental and clinical studies are presented demonstrating that ^{18}F is an especially suitable agent for bone scintigraphy, not only for these reasons but also, despite the fact that repair processes in bone occur relatively slowly, by virtue of its high uptake in regions of osteogenesis and its rapid clearance from blood and soft tissue. Further, the high count rates obtainable with ^{18}F make possible the digital processing of the acquired data by computer analysis. Clinical results obtained with a scintillation camera connected on-line to a PDP-8 computer for data processing are presented, data being processed by correction by means of a homogeneous phantom and subsequent mathematical filtering. Such processing is shown to lead to improved visualization of lesions and to facilitate delineation of their extension, and to be especially useful in the survey of asymmetrical parts of the skeletal system. (auth)

18707 SKELETAL SCINTIGRAPHY WITH SKELTEC, A TECHNETIUM-POLYPHOSPHATE COMPLEX. Murray, I. P. C. (Prince of Wales Hospital, Sydney); McKay, W. J.; Robson, J.; Sorby, P. J.; Boyd, R. E. pp 341-353 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The controversy over the value of skeletal imaging has arisen in the past from the lack of a radiopharmaceutical which could provide bone scans of a quality comparable with that obtained in studies of most other organs. Thus, the introduction of ^{99m}Tc skeletal scanning agents should enable a complete re-evaluation of the role of skeletal scintigraphy in view of the very favorable properties of ^{99m}Tc. However, the reputed inability of these agents to withstand thermal sterilization has retarded the application of such ^{99m}Tc complexes. After numerous attempts with various compounds a ^{99m}Tc stannous-polyphosphate complex (Skeltec) has been found which is unaffected by autoclaving, as demonstrated by tissue distribution study and scintigraphic examinations in experimental animals. Although these studies showed that the target-to-non-target ratio was lower than that of other skeletal scanning agents, the properties of ^{99m}Tc did result in superior skeletal imaging. In both animals and humans, it was observed that maximal radionuclide accumulation in bone occurred within one hour, but that skeletal delineation was optimal after three to four hours. This resulted from a reduction in extra-skeletal radioactivity associated with urinary excretion of ^{99m}Tc. Absorbed radiation doses were calculated from these studies and other observations, including measurements of simulated phantoms and of tissue samples obtained by biopsy. In clinical studies, using either a scintillation camera or a rectilinear scanner, the images of normal bone morphology were of a high standard. The demonstration of bone pathology was comparable and usually superior to that obtained with ^{18}F. The majority of patients studied have suffered from metastatic carcinoma which was observed usually to be associated with increased radionuclide uptake, but in several instances the Skeltec accumulation in metastatic lesion was less than in normal bone. As with other bone-seeking agents, Skeltec permits demonstration of many other pathological lesions, e.g. primary bone tumors, Paget's disease, osteomyelitis, rheumatoid arthritis, and healing fractures. (auth)

18708 COMPARISON OF SCINTIGRAPHIC DATA OBTAINED WITH A MULTIPARAMETER ANALYTICAL SYSTEM AND RADIOGRAPHIC DATA RELATING TO CASES OF ACQUIRED AND CONGENITAL HEART DISEASE. Mourou, M. Y. (Faculte des Medecine, Marseille); Bernard, P. J.; Bisset, J. P. pp 355-364 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Red corpuscles pre-treated with stannous chloride and labeled with technetium-99m provide a tracer of high activity (10 mCi) in a small volume (8 to 10 ml) which remains in the vessels and has dosimetric characteristics compatible with use in children. A sequential study was made of the filling of the heart chambers, after injection of the tracer into the infraclavicular vein, with the help of a floating catheter (cineangioscintigraphy). The activity injected permitted four images per second which were recorded on a 4096-channel analyzer and stored in a magnetic memory. The results can be presented as recorded or after cumulation of a variable number of sequential recordings, depending on the individual case. The results obtained with this method have been compared systematically with those obtained by conventional cineangiography, the main points considered being tolerance of the method and value of the documents obtained. Tolerance to the injection of red corpuscles treated with technetium is always better than tolerance to iodized contrast media and it has therefore been possible to use this technique for case finding in cardiology. The results yield two types of information, dynamic and morphological. The dynamic information, i.e. the rate of progress of the radioactive embolus in the chambers of the heart, can be readily superposed on that derived from radiological examination and can reveal, in particular, the slowing down of pulmonary circulation associated with certain heart diseases. The morphological information shows clearly individualized right chambers but, because of the dilution of the tracer during the pulmonary cycle, less uniform filling of the left chamber. Radiological examination is therefore superior in this respect: the quality of the information obtained is better. However, in the case of congenital heart disease an abnormal flow from left to right is rendered clearly visible on the isotope scan. The method is therefore one that should take its place side by side with angiocardiography, not to replace it, but to avoid unnecessary recourse to it when isotopic exploration reveals a normal situation. (auth)

18709 CRITICAL EVALUATION OF POTASSIUM-43 AND CESIUM-129 FOR QUANTITATIVE MYOCARDIAL SCANNING. Poe, N. D.; Eber, L. M.; Graham, L. S.; Nikesch, W.; MacDonald, N. S. (Univ. of California, Los Angeles). pp 365-378 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The recent availability of ^{43}K and ^{129}Cs has revived interest in myocardial scanning. A study was undertaken to compare imaging characteristics of these two ions for the purpose of quantitating myocardial infarction. Both nuclides were produced on-site in a small biomedical cyclotron. Although better quality images could be obtained with rectilinear scanners, emphasis was placed on scintillation camera imaging because of ease of quantitation. A high efficiency pinhole collimator proved most satisfactory. Modulation transfer functions showed poorer resolution with ^{43}K due to collimator penetration from the 0.619 MeV photons. After intravenous injections in dogs, between 5 to 8% of the administered dose concentrated in myocardium. Potassium reached peak values in 10 to 20 min, then cleared rapidly ($T_{\frac{1}{2}}$ 6 h). Cesium turnover was slower with a peak between 1 to 3 h and a $T_{\frac{1}{2}}$ approaching one day. Myocardial extraction efficiency, determined by direct intracoronary injection, was 70% for potassium and 20% for cesium. Acute and chronic ischaemia and/or infarction were produced by ligation of the anterior descending coronary artery at different levels. Small lesions were not detected in vivo and even large lesions were often not clearly enough defined for quantitation. Correlative studies were performed in patients undergoing cardiac catheterization and ventriculography. With nuclide doses up to 2.5 mCi by intravenous injection and 1.0 mCi by intracoronary injection, satisfactory anterior and right and left anterior oblique views are obtainable. The anterior image represents left ventricular and septal muscle mass with a central ventricular cavity defect. There was also a tendency for diminished apical activity. These factors combined to obscure anterior and apical lesions. Resolution was further reduced by a low 4:1 target-to-background ratio after intravenous injections. The ratio was increased to 7:1 with cesium by intracoronary injection. Although the myocardial extraction of potassium is more efficient and gives higher ratios, this advantage was quickly lost by its more rapid clearance. In over 30 patients studied by intravenous and/or intracoronary injections of ^{129}Cs and ^{43}K only large abnormalities such as aneurysms could be defined consistently. It was concluded that radiopharmaceuticals with greater myocardial specificity are needed for quantitative measurement of regional myocardial ischaemia. (auth)

18710 ATRAUMATIC MEASUREMENT OF THE DISTRIBUTION OF MYOCARDIAL BLOOD FLOW USING POTASSIUM-43 AND A SCINTILLATION CAMERA. MacIntyre, W. J.; Botti, R. E.; Ishii, Y.; Pritchard, W. H. (Case Western Reserve Univ., Cleveland). pp 379-393 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Although single and double probe measurements have been used successfully for determining total myocardial blood flow or flow per unit mass, it has been difficult to determine regional distribution of myocardial blood flow except by the use of moving or stationary scintigraphic devices. Most of these scanning procedures, however, have involved the introduction of radioactive material by catheter into one or more coronary arteries. This type of injection has been used for dynamic measurements of flow by calculating the clearance of ^{133}Xe from the myocardium as well as for static measurements wherein the relative deposition in the myocardium of tagged macroaggregated particular or microspheres was determined. The same objective was achieved by the less traumatic procedure of injecting ^{43}K into a peripheral vein rather than into a coronary artery. In this technique approximately one millicurie of ^{43}K is injected by rapid bolus into an antecubital vein and successive fast frames of digitized distributions of the passage of the material through the heart are recorded by scintillation camera. The counting rate of the injected dose is measured in situ and by use of Sapirstein's relationship, total myocardial blood flow may be derived by determining the ratio of the amount of the dose deposited in the myocardium to the injected dose, and multiplying by the cardiac output. Deposition of the ^{43}K in the myocardium is determined by summating the successive frames at a later time when most of the material has been cleared from the blood. The outline of the heart border as delineated by the rapid passage can be superimposed on the ^{43}K accumulation phase in order to identify specific regions of the heart for which relative flow values may be derived. The immediate application of this method is to the evaluation of variation of myocardial flow following coronary vein-bypass grafts. Because the procedure involves little or no discomfort to the

patient however, its use to follow the course of myocardial infarction from acute phase to recovery merits serious consideration as does its application as a screening test for changes in regional myocardial flow with age, exercise, diet, or other factors. (auth)

18711 INDIUM-113m SULPHIDE MACROAGGREGATE (InSMA). A New Lung Scanning Agent. Tubis, M.; Cohen, M. B.; Wagner, M. S.; Gilliam, C. D. (Wadsworth Hospital Center, Los Angeles). pp 395-402 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The development of an agent for perfusion lung scanning which was easy to prepare, using the desirable long-life $^{113}Sn-^{113m}In$ generator, usable with present instrumentation and biodegradable, and leaving no metallic residues is reported. The agent is prepared by precipitating ^{113m}In sulfide and sulfur in the presence of gelatin as a protective colloid, then denaturing the gelatin with glutaraldehyde and dispersing to the desired particle size. The method is described in detail. Particle size determinations showed the maximum number to be of the mean size of 20 to 25 μm with a range of 5 to 50 μm. One hour after injection, 91.5 to 96.2% of the injected dose of radioactivity was found in the lungs. The distribution in the other organs was determined also. Biological half-life and clearance from the lungs were determined using similarly prepared ^{114m}In and ^{111}In-sulfide macroaggregates and daily counting. Total body counting was performed daily on mice using an uncollimated probe and scintillation camera. The camera with a pin-hole collimator was used to visualize the pulmonary uptake in mice and rabbits after injection of $^{113m}InSMA$ and $^{111}InSMA$. With the latter, the $T_{\frac{1}{2}}$ of the lung clearance varied from 2.1 to 6.8 days for groups of mice. The InSMA cleared from the lungs was trapped in the liver. It appears that the clearance time is related to the average particle size. Clinical trials on a diverse group of patients were performed using doses of 2 mCi of $^{113m}InSMA$ for lung scanning. The estimated radiation dose to the total body was estimated to be 0.04 rads. Results indicate that this new agent is a better lung scanning agent that ^{131}I serum albumin aggregated and comparable to ^{99m}Tc sulfide-gelatin macroaggregate. No adverse reactions were observed associated with its use in several types of perfusion defects. The $^{113m}InSMA$ has been found to be an excellent lung perfusion scanning agent, easily prepared from a long-life generator product. It is biodegradable by the lungs. Because of its short half-life, repeat scans at short intervals are possible. (auth)

18712 QUALITY IMPROVEMENT OF LYMPH-NODE SCINTIGRAPHY USING A COMPUTER-ASSISTED IMAGE-ENHANCEMENT SYSTEM. Kazem, I.; Turek-Maischeiderova, M.; Verbeeten, E. (Catholic Univ., Nijmegen, Netherlands). pp 403-411 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Radiocolloids labeled with ^{99m}Tc are being used more and more in lymph-node scintigraphy and may gradually replace ^{198}Au radiocolloid. This is because of the obvious advantages of ^{99m}Tc in reducing the radiation dose to the patient while permitting a higher count-rate suitable for employing the gamma-camera. However, the rather low photon energy of ^{99m}Tc-labelled colloids limits the visualization of deeply seated nodes in the pelvis and abdomen. This is even more significant in obese patients where the higher activity level in the more superficial femoral and inguinal nodes compared with the deeper iliac and para-aortic nodes may lead to erroneous interpretations. The quality of the lymph-node scintigraphy was greatly improved by using a computer-assisted image-enhancement system with a gamma camera. The system, which is connected on-line or off-line to a Picker-Dynacamera II, consists of a PDP-8/E computer, a teletype, a storage scope, and a Polaroid-camera scope fitted with rotating color filters for obtaining color Polaroid scintiphotos. The program permits the display of activity ranges in 8 to 16 equal intervals as graded shades of black and white or colors. The image can be further enhanced by changing any or all of three parameters controlling the percent background suppression, the percent maximum counts saturation level, and the percent maximum counts cut-off level. Through these parameters the colors or shades of the processed picture can be regulated to enhance any desired range of activity expressed as a percent of the maximum counts in the matrix. This permits visualization of lower activity ranges. Further, the program permits a 1:2 magnification of any one of five areas located in the center, to the right, left, upper, or lower regions of the total visualized area. A permanent record of the processed image is obtained as a color or black-and-white Polaroid scintiphoto. A comparison of the results obtained in 120 patients with this system and those obtained in 80 patients using the gamma camera alone is presented and the improvement in the quality of the information that it gives is demonstrated. (auth)

18713 RADICAL SURGERY OF CERVICAL CARCINOMA ASSISTED BY RADIOISOTOPE TECHNIQUES. Gitsch, E.; Janisch, H.; Leodolter, S. (Univ., Vienna). pp 413-418 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Two methods of radical surgery of cervical carcinoma, assisted by radioisotope techniques, are described. Type I consists of preoperative subcutaneous administration of ^{198}Au colloid to label regional lymph nodes. After completing classical surgery using the Latzko-Meigs technique in combination with primary regional lymph-node removal, the residual lymph-node tissue is scanned and scan-oriented lymphadenectomy is done. This ensures an indirect therapeutic effect by secondary exstirpation of residual carcinomatous lymph nodes. In type II, the subcutaneous application of labeled gold as done in type I is supplemented by preoperative administration of ^{32}P lipiodol UF. This allows high focal doses to be applied to the carcinomatous lymph nodes and provides for a direct therapeutic effect of radioactive phosphorus. Previously, intraoperative scanning was done with a Magna Scanner using an eye probe additionally in sporadic cases, but later a surgical gamma camera developed in collaboration with Picker Company was used. The system allows for virtually complete lymphadenectomy with resultant improvement of the cure rates. This means that potential relapses can generally be avoided. The kidney and ureter function can be evaluated by intra-operative sequential scintiphotos immediately after termination of classical radical surgery, and corrective surgery for preoperatively obstructed drainage through the efferent urinary system can be checked for its efficacy and further corrected, if necessary, during the same operation. (auth)

18714 COMPARISON OF THE RESULTS OF BRAIN SCINTIGRAPHY WITH THOSE OF OTHER DIAGNOSTIC PROCEDURES IN 355 CASES. Tungsubutra, K.; Kraipibul, P. (Ramathibodi Hospital, Bangkok). pp 421-430 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The results of brain scintigraphy with ^{99m}Tc-pertechnetate were analyzed in comparison with those of other diagnostic procedures such as A-P and lateral plain skull radiography, arteriography, pneumoencephalography, and electroencephalography in 355 cases. Cases were diagnosed positively or negatively according to the findings on the scintigram and positive cases classified as tumors, space-occupying lesions, vascular lesions, or inflammatory lesions. In most cases the diagnosis was verified at surgery or autopsy. In some cases the diagnosis could not be so verified but was finally established by clinical follow-up. The accuracy of scintigraphy both in the detection of lesions and the determination of their size and number was excellent, but in some instances the nature of the lesions could be determined less accurately by scintigraphy than by other specific procedures. The significance of false negative and false positive findings is discussed. Brain scintigraphy may be used with advantage as a screening test before subjecting the patient to other more unpleasant, complex, or hazardous procedures such as arteriography or pneumoencephalography. It also complements other specific procedures in guiding the neurologist or neurosurgeon in the choice between a conservative or an operative approach to management of the equivocal case. (auth)

18715 INDIUM-113m ELUATE BLOOD POOL STUDIES IN BRAIN AND LIVER PATHOLOGY. Lubin, E.; Levitus, Z.; Dujovni, M.; Askenasy, H. M. (Tel Aviv. Univ., Israel). pp 431-434 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

When ^{113m}In, obtained as the acid eluate of a ^{113m}Sn generator, is injected intravenously it is rapidly chelated by the circulating plasma transferrin and, as such, retained in the circulating blood pool. The advantage of this in-vivo marking over other blood pool labels is the extreme simplicity of preparation, its short physical half-life, and the convenient energy of radiation. Blood pool studies have been well established clinically for scanning the

placenta and heart chambers. Experience with its use in brain and liver pathology is reported. The brain blood pool was scanned in six patients with intracranial carotid aneurysms and in twelve patients with arterio-venous fistulae. The main value of the method proved to be its simplicity and reliability for the postoperative evaluation of the surgical procedure in the treated patients. In liver pathology, one hundred blood pool studies were compared with the colloidal scan which had been performed simultaneously. The correlation between the blood pool studies and the pathological findings, which are presented, proved to be of diagnostic significance, similar in some ways to the information obtained from coeliac angiography /ith which this method was also compared in 25 of the cases studied. (auth)

18716 INDIUM-111 AS A BRAIN-SCANNING AGENT. Zeidler, U.; Weinrich, W.; Brunngraber, C. V.; Eckhardt, W.; Junker, D.; Bettels, G.; Kalden, J. (Medizinische Hochschule, Hanover). pp 435-455 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Indium-111 bound to serum was used for brain scanning in 52 patients suffering from various brain lesions in order to evaluate its clinical efficiency. The amount of ^{111}In (16 ng) added to 3 ml of the patient's serum readily bound to transferrin. There was no radioactivity detectable in other precipitation lines by immunoelectrophoresis. After intravenous injection the ^{111}In-transferrin complex left the vascular compartment with the shortest half-life of any known labeled protein. The main reason for this rapid blood disappearance was not excretion, which amounted to only 1 to 3% per day. The ^{111}In-labeled transferrin, or the ^{111}In released from it, accumulated in the liver and bone marrow resulting in a rather high radiation dose to these organs. The reason for this behavior remains unclear since denaturation during labeling could not be revealed by analytical techniques although it cannot be ruled out. In clinical studies ^{111}In bound to serum behaves similarly to iodine-labeled albumin, despite the higher molecular weight of transferrin, and the results were very similar to those reported with the latter tracer, except for a surprisingly large number of positive findings in the group of cerebro-vascular accidents. The scan quality, however, was far superior to that obtainable with iodine-labeled albumin. Although extravasation of the compound occurs within 24 hours, the substance may be useful in detecting tumors close to the base of the skull and in the posterior fossa. The problems of differentiation between various cerebral lesions still remain although the time-dependent accumulation of ^{111}In in different tumors is of valuable help especially in cases of meningioma and glioblastoma. The results may be improved by using serial studies including digital measurements or tumor-to-lesion ratios and work is in progress to develop milder labeling techniques and to synthesize other compounds labeled with ^{111}In which has favorable physical and technical properties. (auth)

18717 RADIOACTIVE SAMARIUM COMPLEXES (^{153}Sm-EDTA AND ^{153}Sm-DTPA) IN MEDICAL SCINTIGRAPHY. Karika, Z.; Pal, I.; Tarjan, G.; Fuezy, M.; Nyul, P. (National Inst. of Oncology, Budapest). pp 457-465 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Two radioactive samarium complexes, ^{153}Sm-EDTA and ^{153}Sm-DTPA, were prepared for use in medical scintigraphy. After successful experiments had been carried out with animals, these complexes were introduced into clinical practice. Bone scintigrams were recorded with ^{153}Sm-EDTA in 30 patients, in 23 of which bone lesions were revealed as areas of increased radioactivity. This increased radioactivity cannot be regarded as specific for tumors because it also appears in inflammatory processes. Brain scintigraph with ^{153}Sm-DTPA was carried out in 10 patients, a brain tumor being outlined in 8 cases. Radioactive samarium complexes are useful in medical scintigraphy because their preparation is simple and cheap and because the γ radiation of ^{153}Sm ensures good conditions for scanning. Further, no side effects have resulted from their application. Their disadvantages arise from the short physical half-time of ^{153}Sm, which may cause difficulties in its transportation, and the β radiation emitted by this nuclide which is an additional hazard to the patient. (auth)

18718 TYPE-SPECIFIC TUMOR PATTERNS IN CEREBRAL SEQUENTIAL SCINTIGRAPHY. Roesler, H.; Stalder, A.; Kinser, J. (Univ., Bern). pp 467-476 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

By using sequential brain scintigraphy, the yield of positive findings in patients with cerebrovascular diseases has been increased by a factor of two. In order to determine whether sequential brain scintigraphy would also result in increased findings in brain tumors, 195 patients with proven brain tumors were examined using ^{99m}Tc-pertechnetate as the tracer. An increase in information was found, and this could be statistically confirmed. The sequential brain scintigraphy consists of three stages: a series of 8 Polaroid pictures taken at 4-sec intervals starting immediately after intravenous bolus injection of 15 mCi of ^{99m}Tc-pertechnetate; an early scintigram of the vascular pools recorded between 3 and 5 min after injection; and a conventional brain scintigram recorded more than 30 min after injection. Arterio-venous malformations showed a regional A-V shunt, with a high retention in Stage II and a low contrast in Stage III. Meningiomas showed a high local contrast and high in retention of pertechnetate. Malignant gliomas showed A-V shunts in I and increasing contrast from II to III. Metastases were characterized by a perifocal edema which was best seen as a localized area with decreased contrast, with the activity in this area increasing from II to III. Sequential brain scintigraphy combines ease of performance of conventional brain scanning with a high probability of tumor-specific delineation of a lesion. The accuracy of the method is as good as that with conventional x-ray angiography, but with much less risk to the patient. The overall accuracy of tumor diagnosis was 93%. (auth)

18719 TWO-COMPARTMENT ANALYSIS BY DYNAMIC DOUBLE-TRACER INVESTIGATIONS WITH THE SCINTILLATION CAMERA. Lange, D.; Schenck, P.; Gerspach, A.; Guenther, R. (Univ., Heidelberg). pp 477-486 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A method based on a modified form of Fick's equation for the analysis of data relating to the extraction of tracers from the circulating blood by organs or tissues is described. The efficiency of the method increases with decreasing intravascular concentration of tracer, but the contribution of the latter cannot be entirely suppressed and for a direct two-compartment analysis of the data, the intravascular volume must be labeled simultaneously with a second tracer. The use of the method is illustrated with reference to scintillation camera measurements of the uptake of tracers by brain tumors. It is shown that the extraction index for ^{99m}Tc-pertechnetate in such tumors is less than 10% initially and falls to zero within 30 min of injection. The transfer rate is thus not constant, being less than 0.0015 min^{-1} initially, i.e. less than 1% of the total transfer rate from the blood. The method uses a very simple model and makes no assumptions about the nature of the extraction process. Reference to published work on multicompartmental analysis based on blood concentration data indicates that such methods are less accurate in fitting second and third order exponential components to the data. The method may be useful in the differential diagnosis of certain diseases. (auth)

18720 QUANTITATIVE EVALUATION OF ARTERIO-VENOUS SHUNTS IN BRAIN TUMORS. Bergmann, H.; Boeck, F.; Brenner, H.; Hoefer, R. (Univ., Vienna). pp 487-495 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Brain scanning by intracarotid injection of ^{131}I-labelled macroaggregated albumin (MAA) showed good arterial perfusion of benign brain tumors, whereas in malignant tumors a decreased particle fixation in the tumor region and an increased accumulation of activity over the lungs was observed. These findings suggest the existence of arterio-venous (a.-v.) shunts in malignant brain tumors. On the basis of these results a technique for quantitating a.-v. shunts in brain tumors was developed. A dose of 200 μCi of ^{131}I-labeled MAA was injected into the internal carotid artery. Digital scintigraphy of the brain and lungs was performed simultaneously using a γ camera with a pinhole collimator and a 4096-channel analyzer. After correction of the scintigram by computer methods the activity distribution of the tracer in the lungs and brain was determined and the a.-v. shunt flow expressed as a percentage of the carotid flow. The reproducibility of the method was assayed by phantom studies. A total of 52 patients with brain tumors was studied in this way and all the patients were subsequently operated. Meningiomas showed a mean shunt flow of 2%, metastases a mean of 5%, astrocytomas 10%, and

glioblastomas 26%. The differences between the means of these tumor types are significant. Besides the pathophysiological problems of a.-v. shunts, a major source of error of the method is the ease of fragmentation and the nonuniformity of the MAA particles used. Therefore, ^{99m}Tc-labeled microspheres were recently substituted for ^{131}I-labeled MAA and the results of six cases are presented. (auth)

18721 OCULAR SCINTIGRAPHY. Safi, N.; Blanquet, P.; Verin, P. (Unite de recherches de l'INSERM, Bordeaux). pp 497-518 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Ocular scintigraphy can be performed effectively using ^{131}I-diiodofluorescein followed by ^{131}I-iodinated chloroquine. The detector used is an Anger scintillation camera coupled to a multiparametric analysis assembly. The collimator is a pin-hole type with a stenopeic opening corresponding to each eye. Scintigraphic examinations are indicated under two specific circumstances: to confirm a malignancy and the melanic nature of a visible tumor, generally at the back of the eye; to look for a melanic tumor when symptoms are present. Diiodofluorescein uptake is simply a proof of the hypervascularity, often associated with the tumor. A coefficient K (K reflects the difference of activity between the two eyes) of less than 20% indicates the possibility of a tumor, but the malignancy is equally possible with smaller values. On the other hand, higher values of K may sometimes correspond to simple hypervascularization or angiomatosis. Therefore, iodinated chloroquine must always be used also. If this gives a positive scan, a melanic malignant tumor is present. This fundamental result has never been proved wrong. (auth)

18722 COMPUTER EVALUATION OF THYROID SCANS IN CLINICAL ROUTINE. Moeller, T.; Gustafsson, T.; Naversten, Y.; Cederquist, E. (University Hospital, Lund, Sweden). pp 519-528 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Computer processing of scintigraphic images has been in routine clinical use since 1971. About 3000 scans were processed by May 1972, of which about 2000 were thyroid scans. The system includes data collection at several scintigraphic units and an advanced terminal connected to a large computer. Processed pictures are presented on an incremental plotter and a line printer as contour maps, isometric displays, semi-grey scale maps, and iso-significant maps. In addition, values of organ parameters such as uptake areas, estimated organ volume, background from circulating activity, and net 24-hour percentage uptake are computed. The original data are stored on magnetic tape for later retrieval. Metz filtering has been found to give the best results for low-activity scintigrams (e.g. thyroid with ^{131}I) since it offers the highest signal-to-noise ratio with preserved resolution. Limitations in the dynamical range of conventional display units often result in severe distortions of the picture. This problem does not exist with computer presentation. Clinically, the system has proved to yield valuable information which cannot be obtained using conventional dot scans. Areas in the thyroid gland with diminished uptake are more distinctly visualized, which is of utmost importance in tumor detection. Computer presentation has revealed areas with high uptake in glands that appeared homogeneous in the dot scan. In such functioning nodules it is possible to quantitatively study regional function through the computed digital data. The reproducibility of the system is of great importance for repetition studies, e.g. thyroid suppression or thyroid stimulation tests and investigation series of patients with thyroiditis or patients undergoing different therapeutic measures. It was shown that the given activity could often be reduced to about 10 μCi ^{131}I with a reasonably good picture quality and a very significant reduction of absorbed dose to the patient as a result. (auth)

18723 NEW APPLICATION OF TUMOR-LOCALIZING RADIOPHARMACEUTICALS. Hayes, R. L.; Edwards, C. L. (Oak Ridge Associated Universities, TN). pp 531-552 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The developments that have occurred in the field of tumor-localizing agents since the 1968 Salzburg IAEA Symposium on Medical Radioisotope Scintigraphy are reviewed. Particular emphasis is placed on the radionuclide ^{67}Ga which, along with ^{111}In, appears to show considerable potential as a general tumor-scanning agent. It may be possible to enhance ^{67}Ga tumor-to-nontumor ratios by administering small amounts of stable scandium (0.5 mg/kg) with or before the administration of ^{67}Ga. (auth)

18724 GALLIUM-67 AS A TUMOR-SCANNING AGENT. Clinical and Physiological Aspects. Haubold, U.; Aulbert, E. (Freie Univ., Berlin). pp 553-564 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Experiments have shown that ^{67}Ga has an affinity for a variety of tumors. On the basis of 105 whole-body scans obtained with ^{67}Ga, findings in patients with malignant tumors, lymphoreticular systemic diseases, and inflammatory lesions are presented. The effect of a tumor-specific treatment is demonstrated by the results obtained with 33 patients, of whom only 8 showed a significant ^{67}Ga accumulation in tumors which were resistant to therapy. On the basis of some clinical examples it is shown that ^{67}Ga may be useful for determining the efficiency of a specific therapy on tumors and systemic diseases. Physiological studies were carried out with ^{67}Ga as a tracer element. After i.v. injection of carrier-free ^{67}Ga-citrate, ^{67}Ga was partly bound to a carrier protein, which was identified as transferrin. Studies on the subcellular distribution of carrier-free ^{67}Ga within the liver cells revealed that most of the element is firmly bound to cell organelles 40 hours after i.v. injection. These organelles were proven to be lysosomes by electron microscopy and marker enzyme determinations. One sample of human pathological material, an excised lymph node of a patient with Boeck's sarcoid, showed a subcellular distribution pattern similar to that found in normal rat liver. After i.v. injection, ^{67}Ga is partly bound to serum transferrin and after cellular uptake it is accumulated by rat liver lysosomes. From the experimental results it was concluded that ^{67}Ga is a promising tool for the differential diagnosis of neoplastic diseases. (auth)

18725 CLINICAL AND EXPERIMENTAL OBSERVATIONS ON GALLIUM-67 CITRATE UPTAKE IN HODGKIN'S AND OTHER DISEASES. McCready, V. R.; Dance, D. R.; Hammersley, P.; Nash, A.; Peckham, M. J. (Royal Marsden Hospital, Sutton, Eng.). pp 565-581 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From seminar-workshop on shielding programmers; Ispra, Italy (16 Oct 1972). See STI/PUB-315; CONF-721027-P2.

Gallium-67 citrate uptake was studied in depth in patients with Hodgkin's disease and colonic lesions. Some 133 patients with Hodgkin's and other diseases were examined 48 hours following the administration of the ^{67}Ga citrate. The scans and clinical findings and other special investigations were compared to evaluate their clinical value in 69 patients with proved Hodgkin's disease. A high correlation between active disease and ^{67}Ga concentration was found and in several cases disease was discovered prior to x-ray diagnosis. This technique was found to be of particular value in evaluating the thorax where x-ray techniques are less valuable, especially after treatment. It is now felt that this technique is indispensable in the management of this particular disease. Twenty patients with colonic lesions were examined after careful bowel preparation. A high correlation was found between malignancy and degree of uptake. Studies were made on the specimens obtained post-operatively to assess the relation between blood flow and ^{67}Ga concentration using in-vitro perfusion techniques with labelled microspheres. So far little correlation was found. The technique is particularly interesting in the study of pre-malignant conditions. To help discover the underlying mechanisms of ^{67}Ga concentration, studies using tissue culture techniques were pursued. Early results indicated a close correlation between DNA synthesis and ^{67}Ga uptake. (auth)

18726 TUMOR DETECTION WITH GALLIUM-67 CITRATE. Manfredi, O. L.; Quinones, J. D.; Bartok, S. P. (St. Vincent's Medical Center of Richmond, Staten Island, NY). pp 583-594 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Gallium-67 citrate scintigraphy was carried out in 400 cases with a variety of malignant, benign, and inflammatory lesions. Autoradiographic studies were also performed which demonstrated a moderate uptake of the radiopharmaceutical by the spleen, liver, and bone marrow. The exact mechanism of localization is unclear, but deposition was seen within the cytoplasm

of the cells, mostly in lysosome-like structures. Gallium-67 citrate is definitely valuable not only in the diagnosis of a variety of primary and malignant tumors, but also in evaluating their response to radiation and chemotherapy treatment. (auth)

18727 ^{67}Ga CITRATE IN CLINICAL AND EXPERIMENTAL STUDIES OF MALIGNANT DISEASES. Arnaiz Bueno, F.; Gomez Embuena, A.; Chamorro Romero, J. L.; Teijeiro Vidal, J.; Ortiz Berrocal, J. (Univ. Autonoma, Madrid). pp 595-605 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In Spanish).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Gallium (^{67}Ga) citrate was used in the study of various malignant diseases. A high percentage of positive indications was found in various primitive and metastatic malignant tumors. There was no correlation between the tumoral deposition of gallium and the results of histological studies. In some cases, important additional information was obtained by digital computer analysis of the data. The behavior of this radiopharmaceutical was studied in various types of experimental tumor (hepatic carcinomas and undifferentiated breast carcinomas) transplanted from humans to rats. In one series of 120 patients with malignant tumors, positive indications were found in 84% of cases. With 12 non-malignant conditions, slight abnormal deposition was noted in only two cases. With the remaining non-malignant cases, there was no pathological deposition of gallium in the benign lesions. (auth)

18728 RECENT ADVANCES IN TUMOR SCINTIGRAPHY USING GALLIUM-67. Langhammer, H.; Hoer, G.; Heidenreich, P.; Kempton, K.; Pabst, H. W. (Technische Univ., Munich). pp 607-614 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Experiences in the use of ^{67}Ga as a scanning agent in 120 patients with various tumors in different regions are described. The results can be summarized as follows: there is no dependence of ^{67}Ga accumulation upon the morphological type of tumor, however, the localization is decisive for tumor detectability, which is only hampered in tumors within the abdominal region; accumulation of ^{67}Ga occurs only in viable tumors, and adequately performed radiotherapy or chemotherapy prevent ^{67}Ga from being concentrated in neoplasms; clinical application of ^{67}Ga thus may be extended to the control of the effectiveness of an adequate tumor therapy; in the use of ^{67}Ga as a tumor-seeking agent a limitation only means the uptake of ^{67}Ga in some non-malignant processes; one fundamental usefulness of ^{67}Ga scintigraphy is the delineation of all lymph-node metastases and other metastatic processes which are difficult to palpate without any hazard for the patient. (auth)

18729 GALLIUM-67 SCANNING IN THE STAGING OF HODGKIN'S DISEASE. Turner, D. A.; Gottschalk, A.; Hoffer, P. B.; Harper, P. V.; Moran, E.; Ultmann, J. E. (Univ. of Chicago Hospital). pp 615-630 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Forty-eight patients were evaluated with ^{67}Ga whole-body scanning as part of a protocol for the staging of Hodgkin's disease. Of these patients 38 subsequently underwent laparotomy, for the purpose of staging, as well as selected superficial lymph-node biopsies. Histological confirmation of sites of Hodgkin's disease was also available for nine patients with involvement of special sites, i.e. sites other than lymph nodes, spleen, or liver, and for one patient with Hodgkin's disease in the liver. The results of the scans were compared with the presence of disease as determined by histological examination of the biopsy specimens and radiographic examination of the chest. In the 38 patients subjected to laparotomy, ^{67}Ga scanning correctly identified 45 of 67 (67%) confirmed sites of disease. While the method was very reliable in the detection of disease above the diaphragm, accuracy in the abdomen was poor. Gallium-67 scanning was particularly useful in patients with disease in special sites. Since the ^{67}Ga scan was the only non-invasive study that indicated the presence of tumor in three such cases, it was crucial in the evaluation of these patients. Gallium-67 scanning is recommended as a useful supplementary examination in the evaluation of patients with Hodgkin's disease. It may identify sites for biopsy which might otherwise be overlooked. (auth)

18730 GALLIUM-67 SCINTIGRAPHY IN BENIGN LUNG DISEASES. van der Schoot, J. B.; van Marle-van der Goot, M.; Groen, A. S.; de Jong, J. (Univ., Amsterdam). pp 633-640 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A high percentage of positive ^{67}Ga scans were obtained in cases of bronchial carcinoma (89%; 48 out of 54 cases) as well as in cases of non-malignant lung diseases. Results are reported from a study of 58 cases of non-malignant lung diseases, in which positive ^{67}Ga scans were found in 22 patients (38%). A good uptake of ^{67}Ga in the lesions was almost always found in cases of acute infection (non-specific and specific) and of active sarcoidosis. Of the 58 patients studied, 10 from 18 with non-specific infections had positive scans and similarly 2 from 15 cases with specific infections, 6 from 10 cases with sarcoidosis, 1 from 5 cases with pulmonary infarctions or fibrosis, 1 from 5 cases with pleurisy, and 2 from 5 cases with benign or dubious malignant tumor were positive. The percentage of positive scans in benign lung diseases has been influenced by the relatively large number of patients with active sarcoidosis or acute infection in this series and the high frequency of positive ^{67}Ga scans in these affections. If acute infection and sarcoidosis are excluded, as they are both clinically recognizable, 9 positive scans were found in the remaining 40 benign lung lesions (2 thymomas, 1 tuberculoma, 1 pleurisy, and 5 chronic inflammations). The probability of malignancy and benignancy of a lung lesion in relation to the results of ^{67}Ga scintigraphy is discussed. (auth)

18731 LOCALIZATION OF GALLIUM-67 CITRATE IN UNSUSPECTED SITES OF NEOPLASTIC DISEASE. Kramer, R. J.; Larson, S. M.; Milder, M. S.; Herdt, J. R.; Johnson, V. T.; DeVita, V. T.; Johnston, G. S. (National Institutes of Health, Bethesda, MD). pp 641-655 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Gallium-67 citrate is currently undergoing intensive investigation as a tumor scanning agent. This radionuclide has been shown to accumulate sufficiently in various neoplasms to allow visualization by photoscanning. Results are reported for a series of thirteen patients with neoplastic disease who demonstrated positive ^{67}Ga accumulation at the time that clinical and radiographic studies revealed no evidence of involvement at these sites. This patient group was selected from a group of over 250 cases investigated with ^{67}Ga citrate. The presence of tumor was subsequently documented by further radiographic study or by histologic examination. It is concluded that ^{67}Ga photoscanning may provide the initial evidence of metastatic involvement in selected cases of neoplastic disease. (auth)

18732 GALLIUM-67 SCINTIGRAPHY: A DIAGNOSTIC AND CONTROL METHOD FOR THE POST-THERAPY PERIOD. Sawas-Dimopoulou, C. (Democratus Nuclear Research Center, Athens); Anezyris, N.; Koutras, G.; Dermetzoglou, F.; Samara, V. pp 657-679 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

Results are reported on tumor localization using ^{67}Ga scintigraphy in more than 200 patients as a check on the entire body. Particular attention was given to the examination of patients suffering from localized malignant tumors where no other radioisotopic method in current use could be applied to obtain an image (rhinopharynx, larynx, and oesophagus, for example). Other malignant tumors of varied localization and histological type were also successfully imaged in a large percentage of cases. Gallium-67 scintigraphy does not appear, however, to be absolutely specific to malignant tumors. Benign lesions (tuberculosis and sarcoidosis) also show an affinity to this isotope, although to a lesser extent than the malignant processes. It may therefore be concluded that ^{67}Ga will indicate certain pathological processes that can then easily be differentiated by appropriate examination. Thus, examination with ^{67}Ga marked the start of a precise diagnosis of malignancy in several cases studied. In addition, ^{67}Ga was used as an indicator of the virulence of the tumor before and after therapy, and during the post-therapy period, when repeated checks were made along with the conventional routine examinations, and ^{67}Ga scintigraphy provided early supplementary information in certain cases. (auth)

18733 POSSIBILITIES AND LIMITATIONS OF GALLIUM-67 IN DIAGNOSING TUMORS. Dvorak, K.; Moritz, G. (Roentgen-institut und Strahlenklinik, Cologne). pp 681-685 of Medical

Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The experience gained during the examination of almost 200 patients for neoplasms with the help of ^{67}Ga scanning is reported. Four groups of patients were studied: non-irradiated patients with various forms of neoplasm in organs and systems, subjects suffering from non-tumoral diseases, patients with recurrence of cancer or metastases following radiotherapy and, lastly, patients examined simultaneously with ^{67}Ga and ^{75}Se labelled sodium selenite, which is also taken up selectively by tumoral tissue. Some examples of tumors revealed by ^{67}Ga are presented. The group of subjects suffering from non-tumoral diseases was examined to determine whether the nuclide is also taken up by non-malignant processes, and changes in the distribution of ^{67}Ga during and after radiotherapy were studied. Results showed that ^{67}Ga has a strong affinity for tumoral tissue. In a few instances, however, the tumors were not shown and large accumulations of ^{67}Ga in non-tumoral tissue were observed. This reduced the value of ^{67}Ga as a tool for finding neoplasms, metastases, and recurrences of cancer. The validity of this method for the diagnosis of neoplasms is discussed. Very often it provides information on the malignancy of lesions, but it must be used in conjunction with other isotopic and clinical methods. (auth)

18734 POSITIVE DIAGNOSIS OF TUMORS WITH SELENIUM-75 SELENITE. Esteban, J.; Vazquez, R.; Fombellida, J. C.; Caballero, O.; Llopis, A. (Servicio de Medicina Nuclear, Valencia, Spain). pp 687-700 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

A study was made to analyze the usefulness of ^{75}Se-selenite in tumor diagnosis and in outlining the active tumoral areas. Uptake of ^{75}Se was studied in 229 patients with malignant tumors after i.v. injection of 250 μCi of sodium selenite, using a γ camera. The value of this tracer as an aid in the diagnosis of lung tumors and its importance in differentiating benign and malignant lesions of the liver and brain is emphasized. In 100 cases of lung tumor studied, a positive and clear uptake of ^{75}Se-selenite was found in 87% of the patients. The tumoral image was clearly delineated, even in the cases in which massive atelectasis or pleural effusion were present. This technique was suitable for selecting the radiation fields to be used in radiation therapy of these patients. For patients in whom conventional scintigraphy indicated the presence of cold areas in the liver, a second study with ^{75}Se-selenite allowed differentiation of the benign and malignant lesion. In the case of hydatid cysts or abscesses of the liver, the scan was similar to that obtained with radiocolloids, whereas the defect was refilled totally or partially in tumoral processes. In primary tumors the uptake was clearly positive in the 10 cases studied. In metastatic tumors, cold areas persisted though usually a comparison of ^{75}Se and conventional scintigrams afforded a discriminating test. The images obtained with ^{75}Se in brain tumors were superior to those obtained with ^{99m}Tc. There was no ^{75}Se uptake in the early stages of cerebrovascular accidents though uptake was sometimes in later stages. The results were only moderately successful in bone and soft tissue tumors. Metabolism of ^{75}Se-selenite was studied in laboratory animals and in man. Its concentration in different organs and its half disappearance time were determined in order to evaluate the most adequate timing for the studies and for radiotherapy. (auth)

18735 POSITIVE GAMMAGRAPHY OF TUMORS WITH ^{75}Se-SELENITE. Distinction of Cancer from Benign Hepatic Tumors. Baptista, A. M. (Instituto Portugues de Oncologia de Francisco Gentil, Lisbon, Portugal). pp 701-714 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The importance of ^{75}Se-selenite as a scintigraphic agent for the localization and characterization of hepatic tumors is discussed. A space-occupying lesion, previously detected in the liver as a filling defect in the distribution of a radioactive colloidal suspension, was shown to give a positive scintigraphic image after administration of ^{75}Se-selenite if the lesion is a cancerous tumor. If it remains as a filling defect in the hepatic distribution of ^{75}Se-selenite, the diagnosis of a non-cancerous lesion can be made. The study was based on a series of 57 patients with hepatic symptomatology where the scintigrams obtained after injection of a radioactive suspension (colloidal ^{198}Au or ^{99m}Tc suspension) showed a space-occupying lesion. Scintigraphy was repeated after intravenous injection of sodium ^{75}Se-selenite. In all the 15 cases where the lesions or lesion were subsequently confirmed as benign (hydatid cysts, amoebic or other abscesses, and cirrhosis) persistence of the filling defect was observed. In all the other cases with primary or metastatic cancer the space-occupying lesions gave positive scintigraphic images with ^{75}Se-selenite. Reference is also made to results obtained with ^{75}Se-selenite as a scintigraphic agent for detection of malignant uterine and renal tumors. (auth)

18736 USE OF INDIUM-111 FOR TUMOR LOCALIZATION. A Comparison of Several Chelates with Gallium-67 in Inflammatory and Neoplastic Lesions, With a Note on Indium-Labelled Bleomycin. Merrick, M. V.; Gunasekera, S. W.; Lavender, J. P.; Nunn, A. D.; Thakur, M. L.; Williams, E. D. (Hammersmith Hospital, London). pp 721-729 of Medical Radioisotope Scintigraphy 1972. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on medical radioisotope scintigraphy; Monte Carlo, Monaco (23 Oct 1972). See STI/PUB-315; CONF-721017-P2.

The distribution of indium chloride and of four simple indium chelates was studied in rats following intravenous administration. It is concluded that, while there are considerable differences in excretion, the distribution of the retained dose is essentially similar for all the preparations studied. A limited clinical trial using $^{111}InCl_3$ as a tumor localizing agent showed that it can be visualized only in a small percentage of large tumors, and does not distinguish benign from malignant lesions. Simultaneous scans with ^{67}Ga and ^{111}In made with a solid state rectilinear scanner confirm the superiority of gallium. Blood studies in man have revealed that the binding of indium to transferrin is preceded by the formation of a short biological half-life substance of high electrophoretic mobility. Initial results with indium-labelled bleomycin indicate that it gives clinically useful tumor to background ratios, and further studies are warranted. (auth)

18737 RADIOMETRY OF THE WHOLE BODY DURING STUDY OF PULMONARY CIRCULATION IN INFANTS WITH CONGENITAL VITIUS CORDIS. Malov, G. A. (Lab. of Radioactive Isotopes, Riga). Med. Radiol.; 18: No. 12, 26-34(Dec 1973). (In Russian).

A method is described for the study of the hemodynamics of pulmonary circulation in infants with congenital vitium cordis. Whole body counting followed injection of ^{131}I-MAA into different regions of the heart for use as an indicator. Such parameters of hemodynamics as the blood flow in the pulmonary artery, bronchial circulation, and true pulmonary circulation were determined with the help of this method in combination with Fick's method. Hemodynamics was studied in 40 infants at the age of 6 days to 2.5 years and weighing from 2.1 to 11 kg, with different congenital pathology of the cardiovascular system. (auth)

18738 USE OF RADIOISOTOPES TO DETECT FOOD-COATED DICHLORVOS IN COTTON RAT BURROWS. Smittle, B. J.; Clark, P. H.; Cole, M. M. (Agricultural Research Service, Gainesville, FL). J. Econ. Entomol.; 67: No. 1, 67-68(15 Feb 1974).

Three gamma emitting radioisotopes, ^{24}Na, ^{131}I and ^{140}La, were put into plastic or aluminum containers and sealed inside wood or dichlorvos blocks that were coated with laboratory chow. When these blocks were taken into burrows by cotton rats, Sigmodon hispidus (Baird), they could be detected with 3 portable instruments. (auth)

18739 DEUTERIUM AND CARBON-13 TRACER STUDIES OF ETHANOL METABOLISM IN THE RAT BY ^{2}H, ^{1}H-DECOUPLED ^{13}C NUCLEAR MAGNETIC RESONANCE. Wilson, D. M. (Univ. of California, Berkeley); Burlingame, A. L.; Cronholm, T.; Sjoevall, J. Biochem. Biophys. Res. Commun.; 56: No. 3, 828-835(4 Feb 1974).

[1-^{13}C, 1, 1-$^{2}H_2$] ethanol and [2,2,2-$^{2}H_3$] ethanol were administered to bile fistula rats. A new technique, ^{2}H, ^{1}H-decoupled ^{13}C nuclear magnetic resonance, was used in attempting to account for the distribution of the isotopic species along the steroid skeleton of 3 to 45 mg of isolated bile acids. The technique revealed ^{2}H incorporation at many carbon sites unambiguously, but has limitations as a quantitative ^{2}H assay at these levels of sample availability. (auth)

18740 GALLIUM-67 SCAN IN CLINICAL ASSESSMENT OF CANCER. Johnston, G. S.; Jones, A. E.; Milder, M. S.; Frankel, R. L.; Kramer, R. J.; Arseneau, J. C. (National Institutes of Health, Bethesda, MD). J. Surg. Oncol.; 5: No. 6, 529-538(1973).

From symposium on staging and prognosis of Hodgkin's disease; Buffalo, NY (22 Mar 1973).

By 1 April 1973, 770 patients with malignancy were studied using Gallium-67 (^{67}Ga) citrate radioisotopic scanning at the Clinical

Center, National Institutes of Health. Of these, 21 had brain tumors, 19 (90%) of which concentrated ^{67}Ga. Forty-four patients with melanoma had 54% of proven sites visualized on ^{67}Ga scan (masses larger than 2 cm were detected in 75% of the sites). Ewing's sarcoma was studied in 15 patients with ^{67}Ga scanning and all 15 primary tumors were visualized. Thirty-two of 43 scans performed on 30 patients with acute leukemia were abnormal. Sites of leukemic involvement in bone marrow and as myeloblastomas in soft tissue contained high levels of ^{67}Ga. Patients with untreated Hodgkin's disease were abnormal in 90% of cases on ^{67}Ga scan with 70% of proven sites of involvement being detectable. Sixty percent of non-Hodgkin's lymphoma sites were detected on ^{67}Ga scans. Approximately 85% of anatomic sites involved with lung cancer were detected on scan. ^{67}Ga citrate whole body scanning has proven to be useful in diagnosing and staging a wide variety of human tumors. The ^{67}Ga study is most reliable when positive findings are recorded, but should be approached with caution when the findings are negative. (auth)

18741 USE OF GALLIUM-67 SCANNING IN THE MANAGEMENT OF LYMPHOMA Bakshi, S.; Bender, M. A. (Roswell Park Memorial Inst., New York). J. Surg. Oncol.; 5: No. 6, 539-549(1973).

From symposium on staging and prognosis of Hodgkins's disease; Buffalo, NY (22 Mar. 1973).

There has been considerable interest recently in the possibility that gallium-67 citrate may be of clinical value as a tumor seeking scanning agent. Since its discovery by Edwards and Hayes (1969), a number of reports have been published recording uptake in a variety of tumors, both primary and metastatic (Higasi et al., 1970; Winchell et al., 1970). The observation of Hayes et al. (1970), based on autoradiographs of experimental tumors, that the radioisotope is taken up in the cytoplasm in malignant cells and that uptake is greater in viable than in necrotic tumor has stimulated its use in following patients with lymphoma to assess the efficacy of the therapy administered. At our Institution an assessment has been made of the potential value of ^{67}Ga citrate scanning in the management of lymphoma. Interesting scans showing the usefulness and difficulties with this agent are presented. A total of 79 scans were reviewed. The majority of the patients studied has received either chemotherapy or radiotherapy prior to scanning. Uptake was detected in 42 cases with active disease (53%); no uptake was noted in 28 cases (36%) without active disease, and in 9 cases (11%) the scan gave a false-positive or a false-negative result. The conclusions of this study are: ^{67}Ga scanning is useful in establishing the extent of lesions as well as the presence of undetected disease; and ^{67}Ga scanning is especially useful for the evaluation of the effectiveness of therapy. (auth)

18742 MULTIPLE RADIONUCLIDE DEMONSTRATION OF A PANCREATIC PSEUDOCYST. Rockett, J. F.; Miller, K. D. Jr. (Baptist Memorial Hospital, Memphis, TN). S. Med. J.; 67: No. 1, 120-121 (Jan 1974).

A pancreatic pseudocyst was delineated using a multiple radionuclide technic. A liver scan using ^{99m}Tc sulfur colloid demonstrated extrinsic pressure upon the inferior aspect of the liver. An abdominal blood pool scan using ^{99m}Tc pertechnetate outlined the mass exerting the pressure upon the liver. The diagnosis of pancreatic pseudocyst was suggested from these studies. The technic of the studies and the use in evaluating extrahepatic masses are discussed. (auth)

18743 ^{99m}Tc–TETRACYCLINE AS A KIDNEY AND GALLBLADDER IMAGING AGENT. Fliegel, C. P.; Dewanjee, M. K.; Holman, L. B.; Davis, M. A.; Treves, S. (Harvard Medical School, Boston). Radiology; 110: No. 2, 407-412(Feb 1974).

The biological distribution and kinetics of ^{99m}Tc-labeled tetracycline were studied in rabbits and dogs. The kidneys and gallbladder showed the highest concentration. Autoradiography and dissection of the kidneys revealed preferential uptake by the renal cortex. Excellent static and dynamic images of the kidneys and gallbladder were obtained in both species. These results encourage clinical evaluation of various pathological conditions of the urinary and hepatobiliary systems by this technique. (auth)

18744 DEVELOPMENT OF A RADIOLIGAND TISSUE RECEPTOR ASSAY FOR HUMAN FOLLICLE-STIMULATING HORMONE. Reichert, L. E. Jr.; Bhalla, V. K. (Emory Univ., Atlanta). Endocrinology; 94: No. 2, 483-491(Feb 1974).

A rat testes tubule receptor preparation has been characterized with respect to its usefulness for measurement of FSH activity in fractions derived from human pituitary glands. Highly purified human FSH, iodinated by a modification of the chloramine-T procedure, was employed as the radioligand. A series of human gonadotropin fractions were assayed in the FSH radioligand-receptor assay (RLA) and also in the Steelman-Pohley hCG-augmented rat ovarian weight gain assay (S-P assay), using LER-907 (20 IU/mg) as the assay reference preparation in each instance. The index of discrimination (ID) for a series of hFSH fractions ranging in potency from 53 IU/mg to 3608 IU/mg was 1.05. Highly purified hLH, hTSH and hCG showed ^{125}I-hFSH uptake inhibition activity ranging from 0.9 to 3.6% that of highly purified hFSH. Significant uptake inhibition of labeled hFSH could be obtained with 2.5 ng of pure hFSH, while no uptake inhibition was seen with 10,000 ng of human growth hormone, human prolactin, ovine prolactin, ACTH and human serum albumin. Asialo-hFSH had a potency in the RLA 680 times greater than in the S-P assay, indicating that as with hLH and hCG, sialic acid is not required for receptor binding activity of hFSH. The usefulness of the RLA in following the combination of subunits of hFSH was also demonstrated. (auth)

18745 SIMPLE AND CONVENIENT METHOD FOR SAMPLING CARBON-14 IN THE EXPIRED BREATH. Kumaran, K. A.; Wiener, S. N.; Thomas, J.; Katz, J. B. (Mount Sinai Hospital, Cleveland). Radiology; 110: No. 2, 478(Feb 1974).

To identify gastrointestinal absorption of ^{14}C-labelled fats, bile salts and lactose, and the radiation levels for personnel exposed to the isotope, a method using disposable plastic bags was devised for collecting and sampling expired $^{14}CO_2$. The system is convenient for the patient and technologist, and multiple simultaneous examinations are easily performed. (auth)

18746 USE OF A RADIOMETRIC TECHNIQUE FOR THE RAPID DETECTION OF GROWTH OF CLOSTRIDIAL SPECIES. Evancho, G. M. (Campbell Inst. of Food Research, Camden, NJ); Ashton, D. H.; Zwarun, A. A. J. Food Sci.; 39: No. 1, 77-79 (1974).

Cultures consisted of a mixture of vegetative cells and spores of several species of Clostridium. Culture media and methods are described. The technique for detection of growth was based on the release and detection of $^{14}CO_2$ produced by bacterial metabolism of ^{14}C-labeled substrates in the serum vials. Results showed that, depending on the organisms and the medium used, detection could be as rapid as 4 hr. (HLW)

18747 RADIOIMMUNOASSAY OF ESTRADIOL-17β WITHOUT CHROMATOGRAPHY. England, B. G.; Niswender, G. D.; Midgley, A. R. Jr. (Univ. of Michigan, Ann Arbor). J. Clin. Endocrinol. Metab.; 38: No. 1, 42-50(Jan 1974).

Several radioimmunoassays for the estimation of estradiol-17β in serum have been reported. For the generation of antisera, the majority of these methods have used steroids conjugated to a carrier protein through sites on the A or D rings. The resulting antisera have shown considerable cross reactivity with related steroids necessitating the use of various chromatographic separation steps prior to the actual radioimmunoassay. The use of haptens in which the carrier protein was conjugated to a steroid molecule through carbon 6 on the B ring (1,2,3) has resulted in the production of highly specific antisera. Conjugation of the protein molecule to other positions which leave the A and D rings available for recognition by antibody should also result in the generation of antibodies with enhanced specificity. In this report, an antiserum was prepared to a conjugate of an 11β-hemisuccinate derivative of estradiol-17β to bovine serum albumin. The resulting antiserum appeared to be specific for 17β-estradiol and was sensitive to substitutions on the A, B and D rings. With the use of this antiserum, it has been possible to develop a sensitive, accurate and specific radioimmunoassay for the estimation of estradiol-17β in sera from humans. This antiserum was sufficiently specific to allow the use of a simple benzene extract of serum without subsequent chromatography. The use of iodinated E_2-β-11α-TME as labeled tracer further simplified the procedure by allowing the use of gamma ray spectrometry, rather than liquid scintillation counting with its attendant expense and inconvenience. (auth)

18748 ROLE OF RADIONUCLIDE IMAGING IN SPLEEN TRAUMA. Lutzker, L.; Koenigsberg, M.; Meng, C. H.; Freeman, L. M. (Yeshiva Univ., New York). Radiology; 110: No. 2, 419-425(Feb 1974).

Sixteen patients with abdominal trauma and possible spleen injury were screened by radionuclide imaging. A multiple-view negative examination appears to weigh heavily against any significant splenic injury requiring surgical intervention. Angiography probably is not needed if the spleen scintigram is negative. False positive examinations may be minimized by performing oblique and angulated views, bearing in mind the potential existence of normal grooves and clefts such as rib imprints. Unexplained bands and areas of diminished activity may be encountered. Careful correlation with the patient's history, physical

findings, and clinical course should clarify such problems. Angiography may be necessary in many of these cases. (auth)

18749 MEASURING RENAL UPTAKE OF $^{197}HgCl_2$ BY GAMMA CAMERA. Raynaud, C.; Jacquot, C.; Freeman, L. M. (Service Hospitalier Frederic Joliot, Orsay, France). Radiology; 110: No. 2, 413-417(Feb 1974).

Renal uptake of ^{197}Hg was measured with the gamma camera and a digital scintigraphy system comprising an image digitizer, an analyzer fitted with a 16-K memory, and a Multi-8 computer. In 63 patients, the results were identical to those achieved via the laboratory's reference method (quantitative scintigraphy). With the gamma camera, the ^{197}Hg dose is considerably reduced and examination time cut to less than 30 min per patient. (auth)

18750 POSTERIOR FOSSA INFARCTION: RESULTS OF BRAIN SCANNING. Welch, D. M.; Siegel, B. A. (Washington Univ., St. Louis). Radiology; 110: No. 2, 403-406(Feb 1974).

The brain scans and clinical records of 25 patients with posterior fossa infarction were reviewed. In four patients with a clinical diagnosis of cerebellar hemisphere infarction, the brain scans showed focally increased uptake of ^{99m}Tc-pertechnetate in the affected hemisphere. In 21 patients with a clinical diagnosis of brainstem infarction, the brain scans were normal. In one patient who underwent serial scanning, the evolution of the scan abnormality was similar in time course to that described for cerebral hemisphere infarction. There was no apparent correlation between scan abnormality and prognosis for neurologic recovery. (auth)

18751 RADIOISOTOPE VENTRICULOGRAPHY IN CATS WITH KAOLIN-INDUCED HYDROCEPHALUS. Eisenberg, H. M.; McLennan, J. E.; Welch, K.; Treves, S. (Children's Hospital Medical Center, Boston). Radiology; 110: No. 2, 399-402(Feb 1974).

Movement of radioisotope from the ventricles in normal and kaolin-hydrocephalic cats was studied with a gamma camera. In hydrocephalic cats there was a progression of activity down the spinal axis reaching the region of the filum terminale within 20 min. Systemic absorption, assessed by appearance of activity in regions of the bladder and flank, was delayed when compared with normal cats. This delay corresponded to the time for the radioisotope to travel the length of the spine. This route of flow in hydrocephalic cats was shown by dye perfusion to be via the central canal and filum terminale to the spinal subarachnoid space. Other studies on kaolin-hydrocephalic cats proposing absorption of cerebrospinal fluid by the brain should be reconsidered. (auth)

18752 TOTAL BODY RADIONUCLIDE LOCALIZATION IN INFANTS. Puyau, F. A.; Meckstroth, G. R.; Ho, R. D. (Charity Hospital of Louisiana, New Orleans). Radiology; 110: No. 2, 395-398(Feb 1974).

Forty-nine infants were studied by means of total body radionuclide localization (TBRL) utilizing ^{99m}Tc-DTPA (iron ascorbate) and a scintillation camera. In the 10 infants with abdominal masses, cystic masses caused large areas of diminished tracer localization in images obtained 1 to 3 min after injection and highly vascular masses were identified by displacement and/or distortion of the kidney. The technique is suggested as a correlative method for examining small infants, particularly the newborn. (auth)

18753 TECHNETIUM-99m PHOSPHATE BONE IMAGING: A METHOD FOR ASSESSING BONE GRAFT HEALING. Stevenson, J. S.; Bright, R. W.; Dunson, G. L.; Nelson, F. R. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Radiology; 110: No. 2, 391-394(Feb 1974).

A gamma scanning method was developed for assessing the rate of bone graft healing with the recently developed bone-seeking radiopharmaceuticals ^{99m}Tc-polyphosphate and ^{99m}Tc-diphosphonate. These were utilized to evaluate graft materials placed in surgically created 2-cm defects in the ulnae of mongrel dogs. Radiopharmaceutical scanning was found more sensitive for serial assessment of bone healing than roentgenography. This new method could be an extremely useful clinical tool for evaluating healing of various skeletal abnormalities. (auth)

18754 NEW METHOD FOR RADIONUCLIDE IMAGING OF MYOCARDIAL INFARCTS. Bonte, F. J. (Univ. of Texas, Dallas); Parkey, R. W.; Graham, K. D.; Moore, J.; Stokely, E. M. Radiology; 110: No. 2, 473-474(Feb 1974).

Lesions such as ischemia, which result in myocardial cell death, are accompanied by cellular influx of calcium ions that localize within the mitochondria in the crystalline structure hydroxyapatite. Using ^{99m}Tc-stannous pyrophosphate, an agent that labels hydroxyapatite for bone scanning, the authors have produced scintillation camera images of experimental myocardial infarcts in dogs. Tracer localization disappears with time, suggesting application of this method to fresh infarcts. (auth)

MATERIALS

18755 (AECL-4597) CHEMISTRY AND MATERIALS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1973. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1973. 107p. (PR-CMa-25). Dep. NTIS (U. S. Sales Only) $7.50. AECL $2.00.

Progress is reported in the following fields: solid-state science (ion penetration, electron microscopy, radiation damage, nuclear methods of analysis, nuclear chemistry), general chemistry (analytical chemistry, radioactivity measurements, electrochemistry, mass spectrometry, fuel analysis), physical chemistry (radiation chemistry, $H-H_2O$ exchange, isotope chemistry), materials science (surface chemistry, ceramics, metal physics), and H/D separation. (DLC)

18756 CHANNELING: THEORY, OBSERVATION, AND APPLICATIONS. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973). 486p.

The theory, observation, and application of channeling is covered in 16 chapters, each of which is abstracted separately. (UK)

For abstracts of individual chapters see: 18757–18772.

18757 INTRODUCTION TO CHANNELING. Thompson, M. W. (Univ. of Sussex, Brighton, Eng.). pp 1-35 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

An historical introduction is presented in which reference is made to the early work of W. H. and W. L. Bragg and others, followed by an account of what is meant by channeling. The most striking evidence for channeling came from penetration of ions into or through single crystals. The effect of channeling on nuclear and atomic processes is discussed, and an account is given of backscattering experiments. Also discussed are: star patterns and forward scattering; surface scattering; classical theory of channeling and the limits of classical mechanics; and electrons and positrons. Classical theory works well enough for experiments with protons and heavy ions, although consideration of multiple scattering introduces great complexity. Wave mechanics are essential for consideration of all but the most rudimentary case of electrons and positrons, but calculation is cumbersome and some simpler solution is desirable. Particle trajectories and energy losses will provide insight into the fields that exist within crystals and the interaction of ions with electronic systems of atoms. Advances can be expected in the general field of atomic collision physics. Amongst the applications of ion channeling, the crystallography of defect structures and surfaces are perhaps the most promising, although its direct use in ion implantation may be of greater technical importance. For electron channeling, an important application will be in connection with MeV electron microscopes. (59 references) (UK)

18758 CONTINUUM MODEL OF DIRECTIONAL EFFECTS. Van Vliet, D. pp 37-78 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

Ion beams that are nearly parallel to major axes or planes in a single crystal show distinct directional effects known as the "channeling effect." Ions that originate from an atomic site, for example by nuclear disintegration, are consistently steered away or blocked from orbits parallel to major axes. The "continuum model" shows how such "governed" motion is related to the basic interactions between ions and crystal atoms and to the regular lattice structure. The ion–atom interaction potential along the major axes or planes is averaged so that the scattering is reduced from three to two or one dimensions, and that individual trajectories may be calculated with relatively small uncertainties, although exact solutions are difficult. The advantage of the "continuum model" is that it enables a description of the average properties of a given trajectory or the average properties of an entire beam of ions. The "continuum model" is developed from first principles for both axes and places, and how and why it leads to different types of "governed" trajectories is decribed. Limitations of the model in respect of angular limits and multiple scattering are also described. Amongst matters discussed are: ion–crystal interaction; directional effects near atomic "strings"; planar effects; classification of trajectories; multiple scattering; the rule of reversibility; emission of particles from atoms in a "string"; and the close collision yield for an external ion beam. (27 references) (UK)

18759 COMPUTER SIMULATION OF CHANNELING. Morgan, D. V. (Univ. of Leeds, Eng.). pp 79-114 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

Channeling involves the interaction of an incident ion with a large number of host atoms. One way of handling the problem is to replace the individual interactions by a continuum potential. An alternative method is discussed, which considers each interaction individually with a high speed digital computer. Computer simulation may be used for the direct simulation of experiments. Variation of computed parameters with, e.g., beam energy or crystal temperature may be estimated, allowing the physical phenomena to be isolated and studied. Computer simulation may also be used as an ideal experiment on which to test and develop analytical models. Amongst matters discussed are: computer models (the N-body model, the binary collision model, thermal vibrations, interatomic potentials, inelastic multiple scattering); critical angles and critical approach distances (rigid lattices, vibrating "strings", planes); blocking and channeling half angles; dechanneling; flux enhancement (comparison of analytical and computer calculations, depth oscillations); and range calculations. (37 references) (UK)

18760 ENERGY LOSS OF CHANNELED IONS: LOW-VELOCITY IONS. Poate, J. M. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 115-129 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

For high-energy particles, such as protons or α particles, it is easy to characterize the interactions between the incident particle and electrons of the solid, this energy loss resulting in the ionisation or excitation of the atoms of the solid. Stopping power is inversely proportional to the square of the incident velocity at high energies, but with decreasing energies it passes through a maximum as the ions capture electrons and become neutralized. At lower energies the problem of inelastic electronic interactions becomes more complex, and elastic or nuclear collisions commence to play a strong role in the energy loss process, and these elastic recoils can completely dominate the stopping process at energies of a few keV. The electronic and nuclear contributions to the energy loss are considered to be independent. The elastic scattering cross sections are calculated from screened Coulomb potentials and the electronic contributions from the concept of the ion moving through an electron gas. The electronic stopping velocity and depend monotonically on the atomic numbers of the projectile and the stopping material. The fact that channeled ions are restrained from close encounters with target atoms means that the contribution of nuclear recoils to the energy loss is greatly reduced, allowing measurement of electronic energy loss. The main purpose of this review is to present the current status of theory and experiment in the low-energy region. The studies include mechanisms of radiation damage in reactor materials, and heavy ion measurement in single-crystal semiconductors. (34 references) (UK)

18761 ENERGY LOSS OF CHANNELED IONS: HIGH-VELOCITY IONS. Dearnaley, G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 131-152 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

Experimental observations and theoretical explanations of the energy loss of channeled ions are considered in the Bethe–Bloch region, where ion velocities are well in excess of the maximum orbital electron velocities and the ion may be considered to remain a "bare nucleus". The limiting energy rises with atomic number squared and corresponds to about 100 keV for protons and 1.6 MeV for He ions; thus, experimental evidence is confined to species with $Z \leq 2$. Since the ion may be regarded as an unscreened point charge interacting with a simple Coulomb potential the problem is classically simple, but there is still no fully acceptable theory of the observed behaviour. Progress made over the past decade is reviewed, and an assessment is made of how the problem may be resolved. Several desirable experiments are outlined. A better understanding of the energy loss of fast channeled ions would be useful in the study of crystals by means of a channeled probing beam. It is often important to know, from the energy spectrum of backscattered ions, the depth at which a collision occurs, and this is possible only if the energy loss of the channeled ions can be calculated. (36 references) (UK)

18762 DETAILED STUDIES OF CHANNELED ION TRAJECTORIES AND ASSOCIATED CHANNELING POTENTIALS AND STOPPING POWERS. Datz, S.; Appleton, B. R.; Moak, C. D. (Oak Ridge National Lab., TN). pp 153-180 of Channeling:

Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

The trajectories of channeled ions are governed by interaction of the ions with the interatomic potentials of the planar or axial atoms. In the case of planar channeling, the particles oscillate in a well-defined two-dimensional potential and the trajectories depend only on the initial transverse energy, but for axial channeling the motion is in general less defined. If a particle has insufficient transverse energy to penetrate the potential maxima between adjacent "strings" it will be confined to motion between a single set of "strings", this being known as "hyperchanneling". Where axially channeled particles have sufficient transverse energy to penetrate the potential maxima between strings they may wander between axial channels, their only constraint being the avoidance of small impact parameters with a single string potential. If the detailed trajectory of a particle could be determined, the potentials could be obtained directly. In studies carried out so far, the label identifying a given trajectory has been the energy loss sustained by an ion along its path. Ions moving close to atomic planes and axes pass through regions of higher electron density and hence lose more energy. Amongst matters discussed are: first-order model for planar channeling; "perfect crystal" experiments; potentials and stopping power functions from frequency/stopping power data; potentials from emergent angular distributions; potentials from angular dependence of group populations; and axial potentials from hyperchanneling measurements. (25 references) (UK)

18763 DECHANNELING. Grasso, F. (Univ., Catania, Italy). pp 181-224 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

The probability of a close encounter with a nucleus changes along the path of an ion inside a crystal. The ion may undergo a transition from the channeled beam, where the probability of a close encounter is roughly zero, to a random beam, where the probability is roughly unity. This transition is known as "dechanneling", and experiments on dechanneling are described. Such experiments are important for testing the theory of elementary interactions between a channeled ion and a crystal. Experimental results are described and compared with estimates from Lindhard's theory. The discussion is limited to perfect crystals and light ions. Headings are as follows: Experimental techniques and results (interpretation of backscattering experiments; interpretation of transmission experiments; planar dechanneling; axial dechanneling); dechanneling theory (diffusion equation; axial and planar cases; comparison with experiment); and angular "dips". (49 references) (UK)

18764 RANGE PROFILES. Whitton, J. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 225-258 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

When energetic ions are injected into amorphous material, the resulting distribution or range profile is approximately gaussian and may be derived from the theory of Lindhard. This theory, however, does not take into account any departure from gaussian, owing either to target order or to movement of the implant. The only way to predict accurately the range profiles of injected ions into ordered targets is to make measurements in a wide variety of materials and experimental conditions. A collection of useful data now will allow account to be taken of such diverse matters as incident ion type and energy, target type, orientation, temperature, etc. Sensitive measuring techniques are described, and an assessment is made of the effect of various parameters on the range profile of implanted ions in polycrystalline and monocrystalline metals, semiconductors, and other materials. The possibility of predicting profiles is considered and examples given. (90 references) (UK)

18765 RADIATION DAMAGE. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). pp 259-285 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

If an incident ion beam is aligned close to a major channeling direction of a single-crystal target, the amount of radiation damage, and also the sputtering yield, will be reduced. Sputtering is essentially the manifestation of radiation damage at the surface of a solid. The influence of channeling on the nature of radiation damage is discussed, together with the theoretical findings that provide a framework for the interpretation of experimental results. A variety of experiments is cited, taken from many different sources and types of investigation. Amongst matters discussed are: the observed nature of radiation damage in metals and semiconductors; theoretical aspects; experimental evidence for the effect of channeling (electron microscope studies in metals; field-ion microscope studies; electrical resistivity); dechanneling at defects; and electron channeling. (33 references) (UK)

18766 CHANNELING OF β PARTICLES. Chadderton, L. T. (Univ. of Copenhagen). pp 287-330 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

The scattering of a collimated beam of β particles by aligned simple crystals is discussed on the basis of two models. In one model a single "string" or plane of atoms provides the starting point, whilst in the other model at least one element of the crystal transverse lattice periodicity is retained. For both models forward motion can generally be considered as classical. The second model, however, predicts resonance features which the first model cannot do. Predictions of the two models are identical only when confinement of the β-particle to a wavepacket in the transverse plane is complete. With positrons the action is akin to that of protons, whereby blocked orbits are strongly scattered and highly penetrating channeled orbits have long lifetimes. Conversely, for electrons the channeled orbits are dispersed rapidly, so that for thicker crystals only those orbits referred to as "blocked" can be sustained. (66 references) (UK)

18767 SCATTERING (BLOCKING) PATTERNS APPLIED TO CRYSTALLOGRAPHY. Barrett, C. S. (Univ. of Denver). pp 331-348 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

The patterns produced on films or fluorescent screens by the scattering of a collimated beam of ions impinging on a crystal are frequently referred to as "blocking patterns", because they appear to represent blocking of the emergence, in certain crystal directions, of ions scattered by atoms at lattice points. The basic mechanism, however, is better characterized as a deflection of the scattered ions by collisions with "strings" or planes of atoms in the crystal, and not as abrupt stoppage as implied by the term "blocking pattern". Scattering patterns on a flat film consist of intensity-deficient straight lines located along extensions of the crystallographic planes, and spots located at line intersections, that is, at places on the film where rows of atoms in the crystal, if extended, would intersect the film. The patterns afford much crystallographic information. The apparatus for producing such patterns is not very complex or expensive. The information that could be extracted from such patterns is explored and its potential applications are discussed. Such information includes the nature and crystallographic position, interstitial or substitutional, of impurity atoms, and the nature of imperfections and radiation damage. Matters dealt with include symmetry, indexing, orientation, phase identification, the relation of the pattern to crystal structure, and micrography. (35 references) (UK)

18768 BLOCKING MEASUREMENTS OF SHORT NUCLEAR DECAY TIMES. Gibson, W. M. (Bell Telephone Labs., Inc., Murray Hill, NJ); Maruyama, M. pp 349-389 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

A very interesting application of the blocking of charged particles in single crystals is stated to be in the measurement of the decay time of short-lived compound nuclear states. The history and current status of this application are described, with emphasis on the physical basis of the technique and the most important experimental and analytical problem. The method has now passed beyond the demonstration of feasibility and is rapidly becoming a useful tool in nuclear physics; it offers a unique opportunity for measuring directly lifetimes of the order of 10^{-14} to 10^{-18} s under favourable conditions. Matters discussed include: basic principles; typical results (fission; inelastic scattering; resonance reactions); analysis (simple and complex decay functions; continuum model; computer simulation; "dip" width, area and volume; blocking distribution). It is concluded that blocking studies of nuclear lifetimes form a useful tool, capable of application to important detailed nuclear questions concerning level widths, level densities, nuclear structure matters, fission barrier parameters, effects of specific perturbations such as analogue resonances, etc. It can also be applied to understanding of particle channeling and blocking effects in single crystals. Measurements of simple or well-understood systems are required in order to provide real tests of analytical and experimental techniques. (56 references) (UK)

18769 FOREIGN ATOM LOCATION. Davies, J. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 391-413 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

In the application of channeling to "atom-locating", an important aspect is foreign atom location, particularly in the study of ion-implanted semiconductors, since the technique gives simultaneous information on two important implantation questions:

the amount of radiation damage in an implanted crystal and the type of site on which implanted foreign atoms are located. The technique relies on the ability of a channeled beam to recognise atomic displacements as small as about 0.1 Å with regard to an aligned set of lattice rows or planes. This feature may allow the location of specific atoms within a unit cell to be accurately specified. The basic principles involved in atom location studies are first considered, followed by a more detailed discussion of specific foreign atom detection, with appropriate examples. Amongst matters discussed are: triangulation and lattice symmetry; the substitutional case; flux distribution within channels; some nonsubstitutional examples (B in W—an octahedral interstitial impurity; Zr and Tl in Si—tetrahedral interstitial impurities; Yb in Si—a more complex site; Bi in Si—an "almost substitutional" case; randomly distributed foreign atoms); double alignment; and limitations of the technique. (28 references) (UK)

18770 APPLICATION TO RADIATION DAMAGE. Eisen, F. H. (North American Rockwell Corp., Thousand Oaks, CA). pp 415–434 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

The principles in the application of channeling techniques to foreign atom location in crystals also apply to the study of radiation damage, but there are additional problems, one of which is the inability to distinguish experimentally between reactions of the analysing beam with displaced atoms and with those atoms that have not been displaced. The channeled fraction of the beam interacts only with displaced atoms, whereas ions in the random fraction of the beam interact with all the atoms of the crystal. Separation of these two factors must be included in calculations of the number of displaced atoms. A further difference between foreign atom location and radiation damage applications is that the channeling technique is not as sensitive in the radiation damage case. A close impact process is required for the detection of displaced atoms by channeled ions, and backscattering has been used almost exclusively for this purpose in radiation damage studies utilising the channeling technique; this makes it possible to obtain information concerning the depth distribution of radiation damage, as well as the amount of the damage. One of the current problems with the application of the channeling–backscattering technique, however, is that there is not a clear understanding of what is detected by its use. The foregoing aspects are discussed in detail, together with problems encountered in applying the technique. The principal problems encountered appear to be associated with (i) the dechanneling produced in the disordered material, (ii) the effects of the spatial distribution of the channeled ions, and (iii) conversion of the energy scale of the backscattered spectra to a depth scale. In order to improve on the accuracy of the technique it will probably be necessary to take into account the structural details of defects in estimating dechanneling, and to obtain a better knowledge of stopping powers, particularly as regards the appropriate values to use for channeled stopping and the effects of disorder upon channeled stopping. (24 references) (UK)

18771 APPLICATION TO SURFACE STUDIES. Boegh, E. (Aarhus Univ., Denmark). pp 435–451 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

Channeling can be applied to studies of crystal surfaces and a combination of Rutherford scattering and channeling offers an interesting experimental tool for surface investigations. The method has the following advantages: (i) the process on which the method is based, namely Rutherford scattering of fast protons and He ions, is well understood; (ii) it is possible to perform a quantitative elemental analysis of both the surface and deeper material. For small contaminations the sensitivity is approximately one tenth of a monolayer, while for heavy contaminations it is approximately one thousandth of a monolayer; (iii) it is possible to locate surface atoms relative to the substrate structure; hence surface disorder, surface expansion, and surface vibrations can be studied, and distinguishing between substrate atoms and adsorbed atoms is possible. Furthermore, information about the structure of the substrate below the surface can be obtained simultaneously with information about the surface. Examples of application of the method are given. (13 references) (UK)

18772 APPLICATIONS TO SEMICONDUCTOR TECHNOLOGY. Mayer, J. W. (California Inst. of Tech., Pasadena). pp 453–471 of Channeling: Theory, Observation, and Applications. Morgan, D. V. (ed.). London; John Wiley and Sons, Inc. (1973).

The performance of semiconductor devices depends critically on the distribution of dopant species within the first few micrometres of the surface, and the stoichiometry of the surface layer and its dependence on preparation techniques are important factors. These are areas that can be investigated by channeling of energetic particles such as He or H ions. Backscattering techniques also have direct application to semiconductor technology, and it is considered how much further insight can be gained from the addition of channeling effect measurements. Ion implantation is a practical technique in the fabrication of semiconductor devices, and channeling of the implanted atoms can lead to increased penetration, that can be utilized to obtain special dopant distributions in a semiconductor. Thus the combination of ion implantation and channeling can have advantages for certain applications, and the application of channeling techniques may be used to gain a better understanding of processing methods used in fabricating semiconductor devices. It is emphasized, however, that the present techniques utilized in channeling effect analysis have limitations in their ability to detect small concentrations of dopant atoms, or lattice disorder. The properties of heavily doped semiconductors are not well understood, and channeling effect measurements may play an important part here. Amongst matters discussed are: lattice location of dopant species; lattice disorder; metal layers on semiconductors; surface analysis; and beam effects. (54 references) (UK)

18773 ELEKTRONNYE I IONNYE PROTSESSY V TVERDYKH TELAKH. VI. (Electronic and Ion Processes in Solids. VI). Tbilisi, USSR; Izdatel'stvo Metsniereba (1973). 167p.

Fifteen papers on the radiation physics of crystals and on the theory of crystals with defects are compiled. The papers on the radiation physics of crystals contain the results of studies on the formation of microstructures of ionic crystals under the influence of nuclear radiation. Local and resonance oscillations in crystals with impurity and radiation defects are considered. The specific heats, thermal conductivity, ionic conductivity, and kinetics of the formation of complex vacancies are examined. Papers on the theory of crystals with defects contain the results of studies on the effect of impure centers and lattice defects on the magnetic and kinetic properties of solids. (tr-auth)

18774 SPIN–ORBIT PARAMETER VARIATION OF RARE EARTH IONS IN CRYSTALS. Lowther, J. E. (Univ. of the Witwatersrand, Johannesburg). Chem. Phys. Lett.; 23: No. 3, 446–448(1 Dec 1973).

Calculations of the variation in magnitude of the spin–orbit parameter for substituted Yb^{3+} due to covalence effects suggest the effect to be anisotropic and small. Interaction with the 5p configuration contributes to the spin–orbit splitting, this effect possibly being larger than that produced by covalency. (auth)

18775 FOURTH INTERNATIONAL LIQUID CRYSTAL CONFERENCE, KENT, OHIO, AUGUST 21–25, 1972. Kent, OH; Kent State University (1972). 63p. (CONF-720831-(Absts.)).

Summaries of 171 papers contributed to the conference are presented along with a list of 10 plenary lectures and session schedules. (JRD)

18776 EXPERIMENTAL METHODS IN SHOCK WAVE PHYSICS. Taylor, J. W. (Los Alamos Scientific Lab., NM). pp 107–128 of Metallurgical Effects at High Strain Rates. Rohde, R. W. (ed.). New York; Plenum Publishing Corp. (1973).

Methods for producing and analyzing large-amplitude stress waves in solids are described. Free surface, shock particle velocity, and analog stress measurements are also considered. Measurement of temperature and magnetic effects in shocked solids and their recovery are discussed. (9 figures, 25 references) (DLC)

18777 ELECTRONIC PROPERTIES OF MATERIALS. A Guide to the Literature. Volume Three, Part One. Grigsby, D. L. (ed.). New York; Plenum Publishing Corporation (1971). 1169p.

An index of material names with accession numbers is presented alphabetically in the volume. These accession numbers are used to locate corresponding numbers in Part Two referring to bibliographic citations. (JRD)

18778 ELECTRONIC PROPERTIES OF MATERIALS. A Guide to the Literature. Volume Three, Part Two. Grigsby, D. L. (ed.). New York; Plenum Publishing Corporation (1971). 761p.

The bibliographic citations are input by computer. Each citation is in upper case and in English. The original language of foreign articles is given in parentheses following the title. See Part One for an index of properties of materials cited. (Approximately 16,800 references) (JRD)

Ceramics and Cermets

Refer also to abstracts 18216, 18863, 18872, 18878, 20031, 20032, 20038, 20069, 20071, 20141, 20149, 20158–20160, 20163–20165,

20171, 20172, 20180, 20182, 20185–20187, 20190, 20287, 20288, 20290, 20295, 20537, 20539, and 20556.

18779 (AEC-tr-7518) HIGH-TEMPERATURE STUDIES OF SYSTEMS FORMED BY ZIRCONIUM DIOXIDE WITH SAMARIUM AND GADOLINIUM SESQUIOXIDES. Rouanet, A.; Foex, M. Translated from Compt. Rend., Ser. C; 267: 873-876(1968). 5p. Dep. NTIS $3.00.

The systems $ZrO_2-Sm_2O_3$ and $ZrO_2-Gd_2O_3$ were studied at very high temperature up to melting of the products. The proposed diagrams define the thermal and structural characteristics of phases above 1800°C for different compositions. (auth)

18780 (ANL-8022) CHEMICAL ENGINEERING DIVISION FUELS AND MATERIALS CHEMISTRY SEMIANNUAL REPORT, JANUARY–JUNE 1973. Chasanov, M. G.; Johnson, C. E.; Dudey, N. D.; Blackburn, P. E.; Fluss, M. J.; Heinrich, R. R.; Johnson, I.; Martin, A. E.; Tetenbaum, M.; Crouthamel, C. E.; Levenson, M.; Vogel, R. C.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-31-109-Eng-38. 72p. AT.

To aid in evaluating the performance of fast-breeder reactor fuels, high-temperature studies are being made of the U–Pu–O–Na and U–Nd–O systems and modeling studies of oxygen potentials over oxide fuels are being performed. Additional tests of the reaction of sodium with mixed-oxide pellets and powder are reported. Oxygen potentials over the U–Nd–O system are reported. Applications of the previously presented theory for oxygen potentials over urania-plutonia systems are made to the evaluation of analytical methods for oxygen determinations in U–Pu–O fuel. Laboratory experiments are being performed to assess the effect of selected fission-product elements and other potential fuel-element impurities on the attack of stainless steel cladding. The effect of solution-treating of Type 316 stainless steel on the rate of attack of the steel by cesium compounds is reported. Results of ion microprobe analysis of an irradiated fuel for fission-product cesium are presented. Conditions leading to the reaction of fission-product cesium with urania blanket pellets are discussed. Fast-neutron dosimetry techniques are being developed to improve the accuracy of fission-rate measurements by foil activation and by solid-state track recorders (SSTRs). Results of fission-rate measurements by these two methods are compared with results obtained from fission chambers in the same irradiation. A study to assess the feasibility of extending the use of fast-reactor dosimetry techniques to higher neutron energies is described; these dosimetry techniques are of interest for studying irradiation damage effects in neutron environments applicable to controlled thermonuclear research. (auth)

18781 (CNLM-1349) LITERATURE SURVEY ON RADIATION STABILITY OF BORON CARBIDE. Heasley, J. H. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 2 Jan 1959. 9p. Dep. NTIS $3.00.

Declassified 19 Sep 1973.

Results of the survey are presented, including data and information on the effects of irradiation on dimensional stability, gas evolution, and microstructural damage in B_4C. Information is also included on relations of irradiation atmosphere with B_4C radiation damage. (JRD)

18782 (GEMP-263) $UO_2-UO_3-Y_2O_3$ SYSTEM AND EVALUATION OF THE $UO_{2.5} \cdot 3Y_2O_3$ COMPOSITION. White, J. F.; Juenke, E. F.; Burgbacher, D. E. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 Mar 1964. Contract AT(40-1)-2847. 58p. Dep. NTIS $5.00.

Declassified 21 Sep 1973.

The tentative $UO_2-UO_3-Y_2O_3$ ternary phase-equilibrium diagram was developed for temperatures to 1700°C. Four phases were identified in the system at the temperatures between 1000 and 1700°C: (1) U_3O_8, (2) a face-centered cubic solid solution, (3) a body-centered cubic solid solution, and (4) a rhombohedral phase of the composition $(U,Y)_7O_{12}$ ranging from 52.5 to 75 mole percent Y_2O_3. The rhombohedral phase ($UO_{2.5} \cdot 3Y_2O_3$) was selected for detailed investigation as a nuclear fuel because it showed unusually good stability in air at elevated temperatures. Preparation, fabrication, and properties of this material are described including use of the material as a cladding on BeO tubes for high specific-power thermal-reactor fuel elements. Property measurements of the $UO_{2.5} \cdot 3Y_2O_3$ composition show that it can be used in air for 500 hours at 1700°C without appreciable loss of UO_2. The strength properties are about the same as those of UO_2. Thermal expansion of the material is very similar to BeO which suggests its use on BeO as a fuel. Electrical conductivity of the material was found to be mainly electronic below 1500°C. Thermal conductivity is slightly lower than that of UO_2. (auth)

18783 (GERHTR-48) VARIATION IN THE ANISOTROPY OF THE CRYSTALLOGRAPHIC ORIENTATION IN PYROCARBON COATINGS OF FUEL PARTICLES AS A RESULT OF ANNEALING AND NEUTRON IRRADIATION. Koizlik, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Jun 1972. 108p. (JUL-868-RW). Dep. NTIS $7.50.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

An optical measurement to determine the orientation anisotropy directly at the pyrocarbon coatings of fuel particles is described. A correlation between anisotropy factors was detected by means of optical and x-ray measurements. The optical measurement is used in detection of the orientation anisotropy and its variation by annealing and neutron irradiation of the particle coatings. Also, dependencies are shown between the material properties of pyrocarbon, annealing or irradiation data, and the anisotropy increase. To explain the measured results, a model is discussed and compared with those suggested in the literature. (auth)

18784 (KFK-1853) STUDIES ON THE MECHANICAL BEHAVIOR OF CYLINDRICAL REACTOR FUEL RODS. Lassmann, K. (Technische Univ. Darmstadt (F.R. Germany). Inst. fuer Reaktortechnik). Nov 1973. 265p. (In German). Dep. NTIS (U.S. Sales Only) $15.25.

Thesis.

The mechanical behavior of cylindrical fuel elements is analyzed. A review concerning the physics and technology of fuel elements is presented along with discussions of element behavior as related to axial symmetry taking into account creep, swelling, and plasticity. Theoretical and numerical solutions (SPAR computer program) are offered for isotropic and anisotropic material properties with any given locality dependence. A theory is developed for the description of anisotropic creep (e.g., in the case of Zircaloy fuel cans in light water reactors). Creep buckling of fuel elements is also examined. The structure of the cladding and the supporting fuel "ring" is replaced by a sandwich model. A numerical method is being developed for the solution (numerical sandwich method). Special cases are described to prove that the accuracy of the method is higher than the accuracy of the data on the materials. (auth)

18785 (KFK-1884) CREEP AND RECOVERY PHENOMENA IN URANIUM–PLUTONIUM OXIDE FUEL. Vollath, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Nov 1973. 120p. (In German). Dep. NTIS (U. S. Sales Only) $8.00.

Creep experiments on uranium–plutonium mixed oxides are described. Besides the stress and temperature dependency of the steady-state creep, a phenomenological explanation of the transient creep behavior is also given. For slightly hypostoichiometric uranium–plutonium dioxide a two-term creep formula is determined. In this formula the two stress exponents are 1 and 4.5. To these stress exponents activation-energy values of 117 and 175 kcal/mol are assigned. With the aid of recovery measurements it is possible to assign to these two terms in the creep formula mechanisms of grain-boundary creep and dislocation climbing. On the basis of the recovery measurements the activation energy of movement of oxygen and uranium ions in uranium dioxide of different stoichiometry is also evaluated. (44 figures, 67 references) (auth)

18786 (N-73-27587) IRRADIATION TEST OF TUNGSTEN-CLAD URANIUM CARBIDE–ZIRCONIUM CARBIDE ((U,Zr)C) SPECIMENS FOR THERMIONIC REACTOR APPLICATION AT CONDITIONS CONDUCTIVE TO LONG-TERM PERFORMANCE. Creagh, J. W. R.; Smith, J. R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 20p. (NASA-TM-X-2834; E-7440). NTIS $3.00.

Uranium carbide fueled, thermionic emitter configurations were encapsulated and irradiated. One capsule contained a specimen clad with fluoride-derived chemically vapor deposited (CVD) tungsten. The other capsule used a duplex clad specimen consisting of chloride derived on fluoride derived CVD tungsten. Both fuel pins were 16 millimeters in diameter and contained a 45.7-millimeter length of fuel. (auth)

18787 (N-73-27588) IRRADIATION OF TZM: URANIUM DIOXIDE FUEL PIN AT 1700 K. McDonald, G. E. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 19p. (NASA-TM-X-2755; E-7277). NTIS $3.00.

A fuel pin clad with TZM and containing solid pellets of uranium dioxide was fission-heated in a static helium-cooled capsule at a maximum surface temperature of 1700°K for 1000 h and to a total burnup of 2.0% of the uranium-235. The results of the post-irradiation examination indicated: (1) A transverse, intergranular failure of the fuel pin occurred when the fuel pin reached 2.0% burnup. This corresponds to 1330 kW-h/cm^3, where the volume is the sum of the fuel, clad, and void volumes in the fuel region. (2) The maximum swelling of the fuel pin was less than 1.5%

on the fuel-pin diameter. (3) There was no visible interaction between the TZM clad and the UO_2. (4) Irradiation at 1700°K produced a coarse-grained structure, with an average grain diameter of 0.02 cm and with some of the grains extending one-half of the thickness of the clad. (5) Below ~1500°K, the irradiation of the clad produced a moderately fine-grained structure, with an average grain diameter of 0.004 cm. (auth)

18788 (N-73-29715) URANIUM DIOXIDE FUEL CLADDING STRAIN INVESTIGATION WITH THE USE OF CYGRO-2 COMPUTER PROGRAM. Smith, J. R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 16p. (NASA-TM-X-68281; E-7447). NTIS $3.00.

Previously irradiated UO_2 thermionic fuel pins in which gross fuel-cladding strain occurred were modeled with the use of a computer program to define controlling parameters that may contribute to cladding strain. The computed strain was compared with measured strain, and the computer input data were studied in an attempt to get agreement with measured strain. Because of the limitations of the program and uncertainties in input data, good agreement with measured cladding strain was not attained. A discussion of these limitations is presented. (auth)

18789 (NAA-SR-1915(Del.)) PLUTO PROGRAM QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1956. Rasor, N. S.; Engberg, C. J. (Eds.). (Atomics International, Canoga Park, Calif. (USA)). 1 Jul 1957. 40p. Dep. NTIS $4.00.

Declassified 27 Nov 1973.

Activities in the project during the report period are summarized. Research is reported on engine performance, reactor materials evaluation, BeO moderator materials, refractory ceramics, and properties of reactor materials. (JRD)

18790 (NAA-SR-1976(Del.)) PLUTO PROGRAM QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1957. Hove, J. E. (Ed.). (Atomics International, Canoga Park, Calif. (USA)). 1 Sep 1957. 33p. Dep. NTIS $3.75.

Declassified 27 Nov 1973.

Research results are reported on reactor fuels and materials development and reactor evaluation. (JRD)

18791 (NAA-SR-5263) EQUIPMENT FOR TORY II-A FUEL ELEMENT FABRICATION. Gardner, W. J.; Carniglia, S. C.; Carpenter, H. W.; Luhman, W. J.; McClelland, J. D.; Richardson, J. H.; Rubin, J. A.; Zehms, E. H. (Atomics International, Canoga Park, Calif. (USA)). 15 Jul 1960. Contract AT(11-1)-Gen-8. 44p. Dep. NTIS $4.25.

Declassified 27 Nov 1973.

A description is given of the equipment for fabrication of beryllia ceramic fuel elements that are designed for a Tory II-A reactor experiment. The fabrication process has been physically subdivided into five principal areas: powder preparation, hot pressing, machining, annealing, and control areas. Powder preparation comprises weighing, mixing, drying, calcining, screening, and batching. Hot press operations include die loading, hot pressing, cooling, unloading, and cleaning. Machine operations required are surface grinding, coring, and edge grinding. The annealing of fuel plates to reduce pressed-in strains and to enhance their fuel retention characteristics is carried out in a hydrogen atmosphere furnace. Principal equipment items used for control of dimensions and composition are as follows: specific gravity balance, Zyglo test kit, optical comparator, transpiration furnace, x-ray spectrometer, and spectrographic laboratory. (auth)

18792 (NAA-SR-5667) THERMAL CONDUCTIVITY AND EXPANSION OF HOT-PRESSED BeO–UO_2 BODIES AT HIGH TEMPERATURES. Taylor, R. E. (Atomics International, Canoga Park, Calif. (USA)). 15 Jan 1961. Contract AT(11-1)-GEN-8. 11p. Dep. NTIS $3.00.

Declassified 27 Nov 1973.

The thermal conductivity of a 99% dense specimen of BeO containing 1.5 wt% MgO and 7.5 wt% UO_2 was measured from 780 to 2220°K. From 780 to 2000°K, the resistivity is expressed as $l/k = 21.67 - 5.241 \times 10^{-2}\ T + 5.147 \times 10^{-5}\ T^2 - 1.163 \times 10^{-8}\ T^3$ cm · °C · s/cal where T is in °K; this may be closely approximated by the simpler expression $l/k = 20.24 \times 10^{-3}\ T - 10.69$ cm · °C · s/cal. Thermal expansions of twenty specimens of fueled BeO ranging from 90 to 99% dense and containing 5 to 15 wt% UO_2 and 0 to 3 wt% MgO were measured from 20 to 1100°C. Although the expansion varied slightly with composition, the equation: $l = l_{25}\ [1 + 6.9515 \times 10^{-6}\ (t - 25) + 2.1737 \times 10^{-9}\ (t - 25)^2]$, where l_{25} is the length at 25°C and t is in °C, expresses the observed expansion of all fueled specimens within 5% from 500 to 1100°C. (auth)

18793 (NAA-SR-6286) PLUTO PROGRAM QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1961. (Atomics International, Canoga Park, Calif. (USA)). 15 May 1961. Contract AT(11-1)-GEN-8. 21p. Dep. NTIS $3.25.

Declassified 26 Nov 1973.

Research and development progress is reported on thermal and electric properties of BeO–UO_2 fuels. Research results are also reported on mechanical properties, microstructure, thermal properties, physical properties, and fabrication of Tory-2A fuels. (JRD)

18794 (NAA-SR-6434) RECYCLING OF SCRAP IN BeO–UO_2 FUEL ELEMENT PROCESSING. Carpenter, H. W.; Gardner, W. J. (Atomics International, Canoga Park, Calif. (USA)). 30 Jun 1961. Contract AT(11-1)-GEN-8. 36p. Dep. NTIS $4.00.

Declassified 26 Nov 1973.

The fabrication of hard, dense, irregular machined ceramic shapes from hot-pressed blanks may involve a relatively high material waste. Re-use of this waste material would effect a considerable saving, particularly in cases such as beryllium oxide or nuclear fuel, wherein the raw material value is high. Hot-pressed pieces of BeO–UO_2 were re-used by crushing, milling, and recombining with virgin co-precipitated BeO–UO_2 powder. The combined powder was hot pressed and tested. Density, strength, and fuel retention were diminished as compared with all-virgin feed material. However, this material can be improved by further development and is still superior to BeO–UO_2 bodies prepared by other methods. (auth)

18795 (NAA-SR-Memo-3955) WEIGHT-LOSS STUDIES OF FUELED BeO BODIES IN THE BLOW TUBE. McKisson, R. L. (Atomics International, Canoga Park, Calif. (USA)). 21 Mar 1960. Contract AT(11-1)-Gen-8. 27p. Dep. NTIS $3.50.

Declassified 26 Nov 1973.

Experimental data of the corrosion of various fueled BeO bodies by flowing moist air are presented and discussed. The observed corrosion rates are tentatively explained as being the sum of the separate rates for the BeO and for the UO_2, weighted according to their volume fractions. Samples having high yttria contents (>80%) were quite stable, but the samples having a nominal 5 to 10% yttria exhibited the same loss rates as did the binary BeO–UO_2 mixtures. However, all the ternary BeO–UO_2–U_2O_3 mixtures tested were quite porous, while the BeO–UO_2 samples were rather dense, so that the relative weight loss rates may reflect differences in porosity as much as differences in reactivity. It is concluded that because of the large "corrosion" losses in these fueled samples, a continuing study of these phenomena is imperative. (auth)

18796 (RT/ING-(73)9) SHORT-TIME IRRADIATION EXPERIMENTS IN HYDRAULIC RABBIT OF STUDSVIK R-2 REACTOR: UO_2–PuO_2 SAMPLES. Calza Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U. V.; Rotoloni, P. L.; Testa, G.; Marsico, B.; Trezza, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Jul 1973. 106p. (In Italian). Dep. NTIS (U.S. Sales Only) $7.50.

30 UO_2–PuO_2 samples bearing solid and cored pellets and spherepac sol-gel were irradiated in the hydraulic rabbit of the R-2 reactor. Data concerning the irradiation and results of the post-irradiation examinations are given. Evaluations are reported concerning the thermal behavior of the pins and the buildup of characteristical structure and its evolution with time. Finally, a dynamic model of the fuel pin behavior during the early life in pile is developed from the experimental results. (auth)

18797 (TID-26332) STATUS OF URANIUM NITRIDE DEVELOPMENT PROGRAM AT THE OAK RIDGE NATIONAL LABORATORY. Part II. Weaver, S. C.; Scott, J. L. (comps.). (Oak Ridge National Lab., Tenn. (USA)). [nd]. 14p. Dep. NTIS $3.00.

From RDT/SNS meeting on materials development for space reactor power systems; Washington, D. C. (23 Apr 1968).

Declassified 27 Nov 1973.

Information is included on encapsulated UN irradiation testing in the Materials Testing Reactor, results of post-irradiation evaluation of UN capsules, and irradiation testing of clad UN fuel pins in the Low Intensity Test Reactor and in the Oak Ridge Research Reactor. (JRD)

18798 (UCRL-5699(Del.)) PLUTO QUARTERLY REPORT NO. 1, JULY–SEPTEMBER 1959. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1959. Contract W-7405-eng-48. 98p. Dep. NTIS $7.00.

Declassified 26 Nov 1973.

Research progress is reported on Tory II-A reactor, materials development, BeO–U criticality measurements, Tory II-C, and nuclear facility construction. (JRD)

18799 (UCRL-5833) EFFECT OF REACTOR IRRADIATION ON THE THERMAL CONDUCTIVITY OF BeO–UO_2 SPECIMENS. Leider, H. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1960. Contract W-7405-eng-48. 11p. Dep. NTIS $3.00.

Declassified 28 Nov 1973.

Specimens of beryllium oxide containing 5.8% by weight of oralloy oxide were irradiated in the Livermore Pool-Type Reactor (LPTR) up to a maximum dose of 8.3×10^{18} thermal neutrons. The temperature of the samples was maintained at 1335 ± 20°C. After the largest irradiation, the relative thermal resistivity, as compared with the unirradiated condition, was R/R_0 = 1.1. (auth)

18800 (UCRL-6704-T) PART II. Development Work on BeO and Fuels. Rothman, A. J.; Cline, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1961. Contract W-7405-eng-48. 15p. Dep. NTIS $3.00.

From 13th high temperature fuels committee meeting; Pleasanton, California (5 Dec 1961).

Declassified 18 Oct 1971.

Research results are presented on preferred orientation in sintered BeO and BeO–UO_2 tubes produced by extrusion. It was found that sintering enhances preferred orientation by causing the grain to grow parallel to the extrusion axis. (JRD)

18801 (UCRL-7036(Pt.3)) TECHNOLOGY OF CERAMIC COMPONENTS. Part 3 of the Tory II-C Program. Rothman, A. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Aug 1962. Contract W-7405-eng-48. 21p. Dep. NTIS $3.25.

Declassified 26 Nov 1973.

Fuel elements for the Tory II-C reactor are described along with fuel fabrication processes and mechanical and physical properties of the BeO–UO_2 fuel materials. (JRD)

18802 (UCRL-7647) ELECTROPHORETIC DEPOSITION OF COATINGS ONTO BERYLLIA TUBES. Nickerson, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1963. Contract W-7405-eng-48. 68p. Dep. NTIS $5.50.

Declassified 26 Nov 1973.

A project to adapt the process of electrophoretic deposition to use for coating the bores of beryllia tubes is described. The use of aluminum and graphite films for rendering the surface of an insulating material into an electrical conductor is described. The apparatus developed and the methods for preparing the necessary suspensions are described. A comparison of three different forms of the zirconia–yttria coating material is made. Coated tubes are evaluated both for coating qualities and their resistance to water vapor attack. (auth)

18803 (UCRL-7792) EFFECT OF REACTOR IRRADIATION ON THE THERMAL CONDUCTIVITY OF FUELED BeO. Leider, H. R.; Tsugawa, R. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Aug 1964. Contract W-7405-eng-48. 24p. Dep. NTIS $3.25.

Declassified 27 Nov 1973.

Radiation effects on the thermal conductivity of BeO–ZrO_2–Y_2O_3–UO_2 fuels were studied. Data and information are presented on irradiation and thermal conductivity. Descriptions of the irradiation experiments are also included. (JRD)

18804 (UCRL-7792-T(Summ.)) EFFECT OF REACTOR IRRADIATION ON THE THERMAL CONDUCTIVITY OF FUELED BeO. Leider, H. R.; Tsugawa, R. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Dec 1964. 7p. Dep. NTIS $3.00.

Declassified 27 Nov 1973.

Radiation effects on the thermal conductivity of BeO–$2UO_2$–ZrO_2–Y_2O_3 fuel elements were evaluated. Thermal conductivity was found to decrease with increasing fission density and decreasing irradiation temperature. (JRD)

18805 (UCRL-12469) CORROSION-RESISTANT COATINGS FOR BERYLLIUM OXIDE FUEL ELEMENTS (PLUTO). Folkers, C. L.; Rothman, A. J.; Snider, G. D.; Sandholtz, W. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Apr 1965. Contract W-7405-eng-48. 18p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

Coatings have been studied as a means of reducing the water vapor corrosion of BeO fuel elements for an air-breathing ramjet reactor (Pluto). A 15 wt % Y_2O_3-stabilized ZrO_2 coating was most successful. Results of tests on coated samples indicated that the corrosion rates were dependent on temperature, humidity, and air velocity. Several possible mechanisms are discussed. A gap develops between the coating and the BeO substrate, limiting the corrosion that can be tolerated. An analytical model was satisfactory in correlating and extrapolating corrosion losses. The results indicate that coated fuel elements can be operated successfully at temperatures up to 1650°C in moist air for flying reactor conditions. (auth)

18806 (UCRL-13130) FINAL PROGRESS REPORT FOR RESEARCH AND DEVELOPMENT PROGRAM, OCTOBER 1, 1963–JUNE 30, 1964. (Coors Porcelain Co., Golden, Colo. (USA)). [nd]. Subcontract 256. 180p. Dep. NTIS $11.00.

For Univ. of California, Livermore. Declassified 26 Nov. 1973.

Research and development progress is reported in sections on fabrication of BeO–UO_2 fuel element components, fuel processing, and production costs for Tory II-C fuel elements. (JRD)

18807 (UCRL-13172) SUMMARIZING TECHNICAL REPORT FOR RESEARCH AND DEVELOPMENT TASK PART 10A. Extrusion Ram Head Materials and Design. Final Report, May 1, 1963–November 30, 1963. Michaelis, A. L. (Coors Porcelain Co., Golden, Colo. (USA)). 15 Dec 1963. 6p. (CPC-901). Dep. NTIS $3.00.

Declassified 18 Oct 1971.

A summary is presented of the findings made after an extensive study into the design and investigation of materials for an extruder ram-head seal. A material was sought as a ram-head material that would give a minimum of contamination, a maximum wear life, the ability to correct for liner imperfections, and good wiping action on the extruder liner. Results of the investigations show that ⅛-inch thick nylon disks approach this closer than any materials tried. Results of further investigations show that teflon material is a satisfactory sealing material, however it tends to peel and contaminate the batch with small particles. "Texide" material is an acceptable sealing material, however, the contamination problem is still present to some extent. "Texide" is a mixture of natural rubber and butadiene laminated with nylon cloth to a depth of ⅜-inch and faced with a plastic impregnated cotton cloth. Polyurethane material does not have the strength to withstand pressures generated by the present process. All attempts to use this material in various configurations failed. (auth)

18808 (UCRL-13180) SUMMARIZING TECHNICAL REPORT FOR RESEARCH AND DEVELOPMENT TASK 4. Additives Investigation. Final Report, May 1, 1963–January 31, 1964. Hartert, G. (Coors Porcelain Co., Golden, Colo. (USA)). 15 Feb 1964. 13p. (CPC-936). Dep. NTIS $3.00.

Declassified 26 Nov 1973.

The additives investigation task was designed to develop an additives system to improve unfueled BeO tube quality and be compatible with the fuel system. The scope of the study was limited to the BeO–Y_2O_3–ZrO_2 system. The principal objectives of the study were determination of suitable additives concentrations and optimization of sintering profiles. It was found that the optimum concentration of ZrO_2–Y_2O_3 in 1:1 mole ratio is 1 wt %. Concentrations below 1% do not produce the beneficial fluxing effects necessary to improve tube quality. Concentrations greater than 1 wt % do not produce appreciably greater fluxing effects. This was true for both 100% virgin and 50% recovered BeO compositions. The optimum sintering conditions for tubes containing 1% ZrO_2–Y_2O_3 were found to be a 4-hour soak period at a temperature of 1500°C. This was true for both 100% virgin BeO and 50% recovered BeO compositions, although densification does occur at lower temperatures in the 100% virgin material. Fired densities in excess of 99% of theoretical were achieved in tubes containing 1% additives sintered under the previously described conditions. Modulus of rupture values of greater than 40,000 psi were obtained in tubes containing 1% additives sintered under the above described conditions. Dimensional stability of the tubes as determined by ID measurement was very good. Variation of average ID from tube to tube in a particular batch was on the order of 0.001-inch. Results of zyglo examination of tubes of both 100% virgin and 50% recovered material were good, the tubes exhibiting no more than an acceptable amount of "starlight" effect. (auth)

18809 (UCRL-14143) CORROSION-RESISTANT COATINGS FOR BERYLLIUM OXIDE FUEL ELEMENTS (PROJECT PLUTO). Folkers, C. L.; Rothman, A. J.; Snider, G. D.; Sandholtz, W. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jul 1965. Contract W-7405-eng-48. 117p. Dep. NTIS $8.00.

Declassified 26 Nov 1973.

Coatings were studied as a means of reducing the water vapor corrosion of BeO fuel elements for an air-breathing ramjet reactor (Pluto). The fuel elements are BeO containing fuel as a second-phase solid solution of 1.06 UO_2 : 1.00 Y_2O_3 : 1.00 ZrO_2 (mole ratios). Various potential coating materials were prepared and evaluated and different coating application techniques were used. The most consistent and successful coating was ZrO_2 stabilized with 15 wt % Y_2O_3, although this coating crazed because its thermal expansion exceeds that of BeO. Corrosion rates were shown to increase with increasing humidity and velocity, and so testing at high velocity was necessary. An analytical model of the coated tube helped to correlate corrosion tests at various conditions. Several mechanisms of loss from coated tubes were considered. Corrosion rates of coated tubes at 1650°C were measured in air containing 10 to 12 wt % water at reactor-like velocities (100,000 Reynolds

number). Extrapolation of this and other data to a realistic reactor ambient humidity of 1 wt % gave losses near 0.1 mg/cm²-hour, or 0.00017 inch in 10 hours, which are considered satisfactorily low. The coating also reduced UO_2 loss to undetectable levels. The corrosion rates of uncoated BeO were also measured, and were slightly higher than but consistent with calculated predictions. (auth)

18810 FISSION-PRODUCT GAS RELEASE IN BURST REGION OF URANIUM MONOCARBIDES. Matsui, H. (Nagoya Univ., Japan); Sakanishi, K.; Kirihara, T.; Tamai, T. J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 512-515(Aug 1973).

The release of ^{133}Xe in the burst region was studied in UC irradiated to various thermal neutron fluences (1.6×10^{15} to 2.9×10^{18} nvt). Continuous heating was employed. Results show three burst stages (inflexion points) for the low doses and two stages for the high doses, and the activation energies are estimated. Results are parallel with recovery of electric resistivity and lattice parameter. (DLC)

18811 EFFECT OF ION IMPLANTATION UPON THE DISSOLUTION OF ANODIC TANTALUM OXIDE IN BUFFERED HYDROGEN FLUORIDE. Pringle, J. P. S. (Chalk River Nuclear Labs., Ont.). J. Electrochem. Soc.; 121: No. 2, 195-202(Feb 1974).

A precise sectioning technique for measuring concentration profiles in anodic tantalum oxide is based on the slow dissolution of the oxide in HF almost saturated with NH_4F. Since many of the profiles to be measured were for radioactive isotopes incorporated by ion implantation, it was necessary to establish whether ion implantation had any effect on the technique. To this end, several stable isotopes were implanted at fluences up to 10^{17} ions/cm². It was found that heavy ions gave rise to sputtering and accelerated the stripping of the oxide; by contrast, hydrogen ions gave no sputtering and decelerated the stripping. The accelerated stripping was attributed to the physical presence of the implanted ions, while the decelerated stripping may be due to the formation of hydrogen bonds between neighboring oxygen atoms in the oxide. When 10^{17} ions/cm² of hydrogen were implanted, a carbonaceous deposit formed on the oxide surface due to the radiative polymerization of adsorbed pump oil molecules; this deposit prevented the oxide from dissolving at all. Implantations involving radioactive species were usually much less than 10^{15} ions/cm², and the accelerated stripping was often negligible; when present, it had no effect on the profile measurements. (10 figures, 22 references) (auth)

18812 PROPERTIES OF BORON FIBERS AND OF BORON–ALUMINUM COMPOSITES IN UNIAXIAL COMPRESSION. Mileiko, S. T.; Sorokin, N. M.; Tsirlin, A. M. (Inst. of Solid State Physics, Moscow). Probl. Prochnosti; 5: 41-45(Jun 1973). (In Russian).

Data from compression tests performed with composites consisting of an aluminum-alloy matrix and boron fibers are examined. Compression curves are plotted for composites containing fibers of various tensile strengths. Compression curves of the fibers are obtained by comparing the compression curves of the composites with those of the matrix. The compression curves of the fibers are found to be straight lines for stresses up to 1200 kg/mm². For composites subjected to compression in the direction of the fibers, the optimum volume fraction of the fibers is found to equal ⅓. (IAA)

18813 THERMAL DILATATION OF OXIDATION PRODUCTS OF SCANDIUM. Hajek, B. (Inst. of Chemical Tech., Prague); Brozek, V.; Duvigneaud, P. H. J. Less-Common Metals; 33: No. 3, 385-386(Dec 1973). (In French).

X-ray-diffraction measurements were made on pre-distilled samples of Sc heated to 1500°C in a vacuum of 10^{-6} mm Hg. The formation of a surface layer of Sc_2O_3 and ScN was observed. Weak but clearly visible lines of hexagonal scandium were still observed at 1500°C. By lowering the temperature to 20°C only the Sc_2O_3 and ScN lines remain visible. The dilatation of the Sc_2O_3 and ScN synthesized from Sc placed at 1200°C in a sealed ampule containing excess N_2 or O_2 was also studied, and the lattice parameters obtained are tabulated. The formation of an Fcc form with a = 4.50 to 4.54 Å coincides with that of ScN. (JSR)

18814 IONIC AND ELECTRONIC CONDUCTIVITY IN Y_2O_3-DOPED MONOCLINIC ZrO_2. Nasrallah, M. M.; Douglass, D. L. (Univ. of California, Los Angeles). J. Electrochem. Soc.; 121: No. 2, 255-262(Feb 1974).

The electronic and ionic conductivities of ZrO_2 were determined as a function of temperature, oxygen partial pressure, and trivalent dopant content. Observations were in reasonable agreement with the proposed defect structure model. Ionic conductivity for undoped zirconia was attributed to doubly ionized oxygen interstitials at high oxygen pressures and to doubly ionized oxygen vacancies at the lower extreme of the oxygen partial pressure. Doped zirconia, contrary to the undoped sample, showed maximum ionic transport at intermediate oxygen pressures. The ionic conductivity, due to extrinsic dopant effects, increased by increasing the amount of dopant and its range extended over a wider oxygen partial pressure. The observed decrease in activation energy for ionic conductivity upon doping was attributed to the formation of anion vacancies whose concentration is directly proportional to the dopant content. The 1 mole percent Y_2O_3 sample showed predominant ionic transport. (13 figures, 24 references) (auth)

18815 PRECIPITATION FROM SUPERSATURATED Nb–C SOLID SOLUTIONS. Viswanadham, R. K.; Wert, C. A. (Univ. of Illinois, Urbana). Met. Trans.; 5: No. 1, 123-126(Jan 1974).

Precipitation of carbides from supersaturated niobium–carbon solid solutions was measured using electrical resistance and transmission electron microscopy. The process is shown to follow a rate law of the form $1 - w = \exp(-t/\tau)^n$ with values of n around 0.6. The activation energy is consistent with diffusion of carbon as the major rate-controlling factor. Transmission-electron micrographs of samples aged in the time and temperature range of resistance measurements (days at 180°C to seconds at 400°C) fail to show any visible precipitate. However, foils aged at 400°C for much longer times show very distinct platelike precipitates. On the basis of this the n value is taken to signify carbon segregation to solute-rich regions on certain planes which later develop into well-defined plates. (auth)

18816 FORMATION KINETICS OF THE SOLID SOLUTION $Dy_2O_3 \cdot 2ZrO_2$. Glushkov, V. B.; Krzhizhanovskaya, V. A.; Keler, E. K. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 649-651(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 719-721(Apr 1973).

Data on the formation rates of solid solutions in the system Dy_2O_3–ZrO_2 at 1300 to 1500°C are presented. Values of the rate constant for the reaction of Dy_2O_3 with ZrO_2 are tabulated, and kinetic reaction curves in the mixture 33.3 mole % Dy_2O_3 + 66.7 mole % ZrO_2 are presented. (JRD)

18817 DEFECT STRUCTURES OF TITANIUM AND VANADIUM MONOXIDES. Alyamovskii, S. I.; Zainulin, Yu. G.; Shveikin, G. P.; Gel'd, P. V. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 665-667(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 735-737(Apr 1973).

An analysis of defect structures in VO and TiO is presented. Results obtained by several authors are considered. It is noted that these compounds have a wide range of homogeneity and a large number of statistically distributed vacancies in sublattices. Characteristic data on density stoichiometry, and vacancy distribution in these compounds, are tabulated. (JRD)

18818 THERMAL EXPANSION OF BISMUTH, CADMIUM, AND ZINC OXIDES. Valeev, Kh. S.; Kvaskov, V. B. (All-Union Scientific-Research and Design-Technological Inst. of Electroceramics, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 645-646(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 714-715(Apr 1973).

The thermal expansion of Bi_2O_3, CdO, and ZnO was measured at 100 to 750°C, using a dilatometer. Results are presented in tables and graphs. (JRD)

18819 INFLUENCE OF IONIZING RADIATION ON THERMAL CONDUCTIVITY OF SINGLE CRYSTALS OF FERRITES AND ANTIFERROMAGNETICS. Shchelkotunov, V. A.; Daniilov, V. N.; Semenov, V. E. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 602-607(Apr 1973).

Translated from Izv. Akad. Nauk SSR, Neorg. Mater.; 9: No. 4, 667-672(Apr 1973).

Thermal conductivity changes due to irradiation were observed in single crystals in which groups of defects (gamma-neutron irradiation and charged particles in "nontransparent" specimens) had arisen. The effects were strongest in specimens with low defect contents at low temperatures. The observed decrease in the thermal conductivities of single crystals of ferrites and antiferromagnetics at comparatively low doses of ionizing radiations agrees to a first approximation with the predictions of the theoretical formulas, provided that we use a model which involves grouping of point defects. The changes in the thermal conductivity and slope of the (R, T) curves for certain compositions after irradiation are the basis, in conjunction with the model, for use of the suggested formulas to estimate the number and extents of radiation defects, and to classify the type of distribution in the lattice (uniform distribution or grouping) according to the integral flux of particles and the type of ionizing radiation. (auth)

18820 REACTIONS OF EUROPIUM MOLYBDATE WITH ALKALI METAL MOLYBDATES. Savel'eva, M. V.; Shakhno,

I. V.; Plyushchev, V. E.; Kuperman, O. M. (Moscow Inst. of Fine Chemical Tech.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 570-573(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater. 9: No. 4, 632-635(Sep 1973).

Using thermal and x-ray phase analysis, the phase diagrams of the systems $Eu_2(MoO_4)_3-M_2MoO_4$ (M is Na, K, Rb, or Cs) were investigated. All the systems have congruently melting compounds of the $MEu(MoO_4)_2$ type for which the melting points and phase transitions have been determined. It has been found that the system $Na_2MoO_4-Eu_2(MoO_4)_3$ contains an $NaEu(MoO_4)_2$-based region of finite solid solutions; a compound which melts incongruently at 680°C and has the formula $Na_5Eu_3(MoO_4)_7$ is formed in this system. In the systems $K_2MoO_4-Eu_2(MoO_4)_3$ and $Rb_2MoO_4-Eu_2(MoO_4)_3$, in addition to compounds of the $MEu(MoO_4)_2$ type, isostructural incongruently melting compounds with the composition $M_5Eu(MoO_4)_4$ crystallize. (auth)

18821 LANTHANUM, PRASEODYMIUM, NEODYMIUM, AND SAMARIUM NIOBATES WITH THE GENERAL FORMULA Ln_3NbO_7. Panova, T. I.; Godina, N. A.; Keler, E. K. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 567-569(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 628-631(Apr 1973).

The conditions for formation of compounds with the general formula Ln_3NbO_7 (Ln is La, Pr, Nd, or Sm) during coprecipitation from solutions and synthesis from oxides were studied. It was found that when the coprecipitation method is used, the compounds La_3NbO_7, Nd_3NbO_7, and Sm_3NbO_7 begin to be formed sooner than in the case of the oxide method but, in both cases, complete synthesis is attained at 1350°C. The formation conditions of Pr_3NbO_7 were investigated for the first time, and it was established that it has the pyrochlore structure. Coprecipitation enables the formation temperature of this compound to be reduced by ~350 to 400°C in comparison with ceramic synthesis. The formation kinetics of Pr_3NbO_7 was investigated, and the apparent activation energy of this process was calculated. (auth)

18822 CROSS SECTION WITH 25 MOLE % Ta_2O_5 IN THE SYSTEM $Eu_2O_3-La_2O_3-Ta_2O_5$. Pinaeva, M. M.; Kuznetsova, V. V.; Ustimovich, A. B.; Shul'man, L. D. (Inst. of Physics, Minsk). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 563-566(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 624-627(Apr 1973).

Using x-ray, electron-microscopic, and luminescence analysis, the cross section of the system $Eu_2O_3-La_2O_3-Ta_2O_5$ with 25 mole % Ta_2O_5 at 1250°C was investigated. It was established that this system contains two types of solid solutions, the boundary between which is located at about 35 mole % Eu_2O_3. (auth)

18823 REACTION IN THE SYSTEM $Y_2O_3-PbF_2$. Sapozhnikov, Yu. I.; Andrushchenko, N. S. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 558-562(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 618-623(Apr 1973).

Results of investigation of part of the diagonal cross section of the mutual system Y, Pb||F, O are presented. Yttrium-containing phases (YOF and $YOF \cdot PbF_2$) are formed in this system. The quantitative ratio of these phases depends on the proportion of Y_2O_3 in the melt. (auth)

18824 PREPARING SINGLE CRYSTALS OF CdS WITH RADIATION-STABLE SENSITIVITY TO IONIZING RADIATION. Kopas, N. F.; Galushka, A. P.; Konozenko, I. D. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 490-493(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 543-547(Apr 1973).

Experimental studies of the effects of impurities on the sensitivity of CdS crystals under gamma and visible light irradiation were conducted. It is found that when visible light or ^{60}Co gamma rays act on single crystals of CdS doped with Ga or In, there is a long-term reversible increase in sensitivity to radiation (for gamma ray doses not exceeding 10^6 R). In crystals doped with Ag or Cu the sensitivity decreases under irradiation. It is possible to compensate the radiation-induced reversible sensitivity changes by doping with an oppositely acting impurity. A method of obtaining single crystals of CdS with radiation-stable sensitivity is described; the necessary dopants are added during growth. (JRD)

18825 SOLUBILITY AND THERMODYNAMIC PROPERTIES OF OXYGEN IN SOLID Mo. Srivastava, S. C. (Semi-Metals, Inc., Westbury, NY); Seigle, L. L. Met. Trans.; 5: No. 1, 49-52(Jan 1974).

The solubility of oxygen in solid Mo, determined in the range 1400 to 1900°C by equilibrating rods of zone-refined Mo with mixtures of Mo and MoO_2 powders, can be expressed as $\ln \chi_O^{sat(ext)}$ (atom fraction) = 5.86 − 27,900/T. Using the known value of the free energy of formation of MoO_2, the chemical potential of oxygen in the dilute solid solution is calculated to be $\mu_O^{\xi} - \frac{1}{2}\mu_{O_2}^{\xi} = \Delta G_T^{\circ} = -10{,}760 + (6.92 + R \ln \chi_O^{\alpha})\,T \pm 1000$ cal/g-atom oxygen. The heat of solution of oxygen in solid Mo is $\Delta H_O^{\alpha} = -10{,}760 \pm 3000$ cal/g-atom oxygen, and the excess entropy for the interstitial solid solution $\Delta S_O^{\alpha}(xs,1) = -9.10 \pm 1.5$ cal/degree, g-atom oxygen, assuming that the oxygen atoms reside in the octahedral interstices of bcc Mo. (auth)

18826 CHARGE TRANSFER IN SOME TRANSITION-METAL SEMIBORIDES. Kohn, A. (Univ., Karlsruhe, Ger.); Merz, H. Phys. Status Solidi (b); 61: No. 1, 147-152(1 Jan 1974).

High-resolution bremsstrahlung isochromats of the semiborides (FeCo)B, Co_2B, (CoNi)B, and Ni_2B are presented. A systematic difference between the isochromats of the borides and those of the corresponding metals can be understood in a simple charge-transfer model. Boron acts as donor and supplies (1.6 ± 0.5) electrons per boron atom. (auth)

18827 EFFECT OF IRRADIATION OF Si_3N_4 LAYERS WITH LOW-ENERGY ELECTRONS. Zieborak, J.; Zak, J. (Inst. of Electron Tech., Warsaw). Electron Technol.; 4: No. 1-2, 221-226(1971).

A 20-keV electron beam was used to eliminate the effects of bias polarization on the current–voltage characteristics of $Al/Si_3N_4/Si$ structures. The efficiency of electron irradiation in eliminating the accumulated charge is dependent on the deviation of the nitride layer from the equilibrium state. Results confirm Kendall's hypothesis of a crystallographic nature of surface charge-density instability in silicon nitride under the influence of an electric field. A saturation effect was observed in the changes of surface charge density as a result of irradiation of previously unpolarized samples. (IAA)

18828 HIGH-TEMPERATURE PHYSICAL PROPERTIES OF FAST REACTOR MATERIALS. Chasanov, M. G.; Leibowitz, L.; Gabelnick, S. D. (Argonne National Lab., IL). J. Nucl. Mater.; 49: No. 2, 129-135(Dec 1973).

Physical properties of materials of interest in fast reactor safety are presented. These include enthalpy and heat capacity, vapor pressure, density, surface tension, speed of sound, viscosity, and thermal conductivity. The emphasis is on saturated fuel materials (UO_2 and UO_2-PuO_2) and coolant (Na). Much of the data is the result of direct experimental measurement while the remainder was obtained by extrapolative techniques from data at lower temperatures. (7 figures, 36 references) (auth)

18829 SELF-DIFFUSION OF C IN HYPERSTOICHIOMETRIC UC. Makino, Y.; Son, P.; Miyake, M.; Sano, T. (Osaka Univ.). J. Nucl. Mater.; 49: No. 2, 225-231(Dec 1973).

The self-diffusion of C in hyperstoichiometric UC was measured in the single-phase region of UC, using a radioactive tracer and sectioning technique. The diffusion equations as a function of temperature are: (i) for $UC_{1.38}$, $D = 0.10 \exp(-(53.5 \pm 10.6)/RT$ kcal/mole) cm^2/sec for the temperature range 2100 to 2230°C; (ii) for $UC_{1.43}$, $D = 0.11 \exp(-(54.6 \pm 4.6)/RT$ kcal/mole) cm^2/sec for the temperature range 1950 to 2150°C. The dependence of the diffusion coefficients and the activation energy is described as follows, (i) when x (C/U molar ratio) $\lesssim 1.11$, the diffusion coefficients increase with x, while the activation energy decreases, (ii) when $x \gtrsim 1.11$, the diffusion coefficients no longer increase with x but remain constant, as does the activation energy, i.e., E is about 54 kcal/mole. The mechanism for C diffusion in hyperstoichiometric UC is considered to be an interstitial or interstitialcy. (9 figures, 4 tables) (auth)

18830 SPECIFIC HEAT ANOMALY OF NONSTOICHIOMETRIC U_4O_{9-y}. Inaba, H.; Naito, K. (Nagoya Univ., Japan). J. Nucl. Mater.; 49: No. 2, 181-188(Dec 1973).

A λ-type specific heat anomaly of U_4O_{9-y}, which occurs slightly above room temperature, was measured for the samples with different O/U ratios. The transition temperatures obtained from the peak of λ-type specific heat anomaly are in fairly good agreement with the data by x-ray diffraction and electrical conductivity measurements. The entropy increment for the transition was 0.46 eu for $UO_{2.240}$, 0.56 eu for $UO_{2.240}$, and 0.70 eu for $UO_{2.228}$, depending on O/U ratio. On the basis of the entropy change with O/U ratio, the mechanism of the phase transition is discussed. The entropy change due to the phase transition is mainly divided into two terms: One is due to the order–disorder rearrangement of U(IV) and U(V) ions, the other is associated with the displacement of oxygens ions. The former term is estimated to be rather smaller than the entropy change calculated by the Bragg–Williams approximation, and the latter is calculated using the x-ray diffraction data with the assumption of the Willis model. (5 tables, 21 references) (auth)

18831 THERMODYNAMIC ESTIMATIONS FOR THE SYSTEM U–Pu–W–C. Ugajin, M.; Takahashi, I.; Suzuki, Y.; Abe, J.; Kurihara, M. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 49: No. 2, 151-160(Dec 1973).

The standard free energies of formation for $UWC_{1.75}$, UWC_2, and $PuWC_2$ are estimated based on phase-diagram data; at 2000°K, they are -41.2 ± 3.0, -45.4 ± 5.0 and -37 ± 10 kcal/mole, respectively. In view of the fuel/cladding compatibility, the carbon activity within a three-phase region ($UC + UWC_{1.75} + W$) is calculated using estimates of $\Delta G_f^\circ(UWC_{1.75})$. It is shown that the carbon activity in the tungsten-buffered UC is considerably lower than in Type 304 stainless steel at 1000°K. Distributions of tie lines in the 2000°K two-phase equilibrium (U, Pu)C + (U, Pu)WC_2 with a total Pu/(U + Pu) ratio of 0.2 are also calculated, predicting an enrichment of plutonium in the (U, Pu)WC_2 phase. The magnitude of the segregation (differences in U : Pu ratios) between the phases seems similar to that in the two-phase equilibria (U, Pu)C + (U, Pu)$_2C_3$, assuming the three solutions behave almost ideally. (5 figures, 33 references) (auth)

18832 ISOTHERMAL GRAIN GROWTH KINETICS IN SINTERED UO_2 PELLETS. Ainscough, J. B.; Oldfield, B. W.; Ware, J. O. (Reactor Fuel Element Labs., Springfields, Eng.). J. Nucl. Mater.; 49: No. 2, 117-128(Dec 1973).

Measurements of grain growth rates were made on twelve types of UO_2 specimens, mainly at temperatures between 1300 and 1500°C. Initial pellet densities were between 94 and 99% theoretical and, since the grain growth anneals were carried out in flowing hydrogen, the materials were stoichiometric throughout the tests. A small amount of work was also carried out at lower temperatures. Results are interpreted in terms of a rate equation, due to Burke, which supposes that grain growth continues only until some limiting grain size is attained. It was shown that the limiting grain size is itself temperature dependent, increasing with increasing temperature. Measurements of grain growth made on irradiated UO_2 can be correlated with the out-of-reactor measurements if it is assumed that the limiting grain size at any temperature decreases with increasing burnup. The calculated time to attain the limiting grain size at ratings around 20 W/gU is less than 50 days. It also follows that the limiting grain size, at a given temperature, will decrease with increasing rating, a fact which needs to be borne in mind when estimating fuel temperatures from grain size measurements. (14 tables) (auth)

18833 DEFECT STRUCTURE OF NEUTRON-IRRADIATED BORON CARBIDE. Jostsons, A.; DuBose, C. K. H.; Copeland, G. L.; Stiegler, J. O. (Oak Ridge National Lab., TN). J. Nucl. Mater.; 49: No. 2, 136-150(Dec 1973).

Boron carbide irradiated in thermal and fast reactor neutron spectra at 500 to 840°C up to 81% ^{10}B burnup was examined by transmission electron microscopy. Helium bubbles formed by agglomeration of helium from the ^{10}B $(n,\alpha)^7Li$ reaction constitute the only visible form of irradiation-induced damage. The helium bubbles tend to have a disc-like morphology with the plane of the disc parallel to (111). Strong lattice strain fields around the bubbles evidenced a lack of thermal equilibrium. Bubble nucleation was influenced markedly by grown-in dislocations and stacking faults. Bubble coalescence, either by impingement or enhanced by bubble stress fields, frequently gave rise to both trans- and intergranular microcracking. The significance of these observations on gas release and swelling of boron carbide are discussed briefly. (12 figures, 24 references) (auth)

18834 STANDARD RECOMMENDED PRACTICE FOR EVALUATING APPARENT GRAIN SIZE AND DISTRIBUTION OF CEMENTED TUNGSTEN CARBIDES. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-390-64).

This procedure is for the visual comparison and classification of the apparent grain size and distribution of cemented tungsten carbides and is limited to WC containing 6, 10, and 18% Co. Requirements are included for specimen preparation, metallographic procedure, and reporting practices. (JRD)

18835 STANDARD SPECIFICATION FOR NUCLEAR-GRADE BeO POWDER. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-C-708-72-a).

Minimal physical and chemical properties are defined for BeO to be used in fabrication of nuclear components. Requirements are included for sampling, testing, and chemical composition. (JRD)

18836 LATTICE DYNAMICS OF A RIGID-ION MODEL FOR GADOLINIUM MOLYBDATE. Boyer, L. L.; Hardy, J. R. (Univ. of Nebraska, Lincoln). Phys. Rev., B; 8: No. 5, 2205-2213(1 Sep 1973).

Calculations are presented which support the view that the ferroelectric phase transition in gadolinium molybdate (GMO) arises from the softening and ultimate instability of a doubly degenerate zone-edge mode of the high-temperature paraelectric phase. A rigid-ion model was used in which the short-range force constants are obtained from a detailed knowledge of the crystal structure together with the conditions imposed by the requirement that the crystal must be in static equilibrium under the combined influence of both Coulomb and short-range forces. Results show that this type of approach is very useful when one is dealing with complex structures such as GMO, which has thirty-four ions per unit cell in the paraelectric phase. In view of the simplicity of the model, a surprisingly good correlation with experimental results was obtained. In particular, the calculated zone-center frequencies reproduce the basic features of the observed Raman spectrum. Dispersion curves are presented which show a pronounced softening of two phonon branches which become doubly degenerate at the M point, in agreement with inelastic neutron scattering. The displacements associated with the soft M-point modes correlate with the difference in the structures of the high- and low-temperature phases determined by x-ray diffraction. This provides further evidence that the ferroelectric domains in GMO are to be interpreted as "frozen-in" soft zone-boundary modes of the paraelectric phase. (auth)

18837 STATISTICAL MECHANICS AND CRITICAL BEHAVIOR OF THE MAGNETOELECTRIC EFFECT IN $GdVO_4$. Gorodetsky, G. (Univ. of the Negev, Beer Sheva, Israel); Hornreich, R. M.; Wanklyn, B. M. Phys. Rev., B; 8: No. 5, 2263-2267(1 Sep 1973).

Utilizing the magnetoelectric (ME) effect, the magnetic space group of $GdVO_4$ was determined to be $I\,4_1'/a'm'd$. The temperature dependence of the ME susceptibility α was measured from 1.6°K to $T_N = 2.43$°K. Using a modified molecular-field theory it is concluded, from the temperature dependence of α, that the mechanism(s) underlying the effect can be an electric-field-induced Dzialoshinsky interaction and/or an electric-field-induced g shift. The magnitude of α indicates that the former mechanism is the more likely one. The critical behavior of α was measured in the range $0.977 \lesssim T/T_N \lesssim 0.999$. A critical exponent of $\beta = 0.50 \pm 0.05$ was found. This is considerably higher than that expected for a three-dimensional two-sublattice Heisenberg model with nearest-neighbor interactions only and is suggestive of higher than first-neighbor exchange interactions which act to enhance the long-range order of the system. Such interactions could have a significant effect on the critical behavior due to the small number of nearest neighbors on the diamond lattice formed by the Gd^{3+} moments. (36 references) (auth)

18838 EuO. I. Resistivity and Hall Effect in Fields up to 150 kOe. Shapira, Y. (Massachusetts Inst. of Tech., Cambridge); Foner, S.; Reed, T. B. Phys. Rev., B; 8: No. 5, 2299-2315(1 Sep 1973).

The resistivity ρ and the Hall effect are studied in seven n-type EuO single-crystal samples at 4.2 to $\lesssim 300$°K and external magnetic fields up to 150 kOe. Attention is focused on three phenomena: (i) the anomalous Hall effect (or lack thereof), (ii) the resistivity peak near the Curie temperature $T_C \simeq 69$°K, and (iii) the insulator-metal transition (IMT). The Hall data at $T \ll T_C$ indicate that the anomalous Hall term in EuO is small compared to the normal term and that the effective magnetic field which governs the Hall effect is equal to the magnetic induction $B = H_{int} + 4\pi M$. On this basis it is assumed that the anomalous Hall effect is negligible at all temperatures. Measurements of $\rho(H_{ext}, T)$ vs T, show that as H_{ext} increases the resistivity peak decreases, becomes broader, and shifts to higher temperatures. The Hall data indicate that the resistivity peak is due to the combined effect of dips in the Hall mobility μ and in the carrier concentration n. Measurements of T_C by several methods show that T_C is several degrees lower than the temperature T_{max} at which the zero-field resistivity is maximum. A new method for obtaining T_C from magnetoresistance measurements is discussed. Near room temperature the resistivity of some samples decreases exponentially with increasing T, with an activation energy of ~0.3 eV at zero magnetic field. For these "activated" samples ρ changes by many orders of magnitude near the IMT. In other samples (called "nonactivated") ρ varies slowly with T near room temperature and the resistivity change near the IMT is smaller. In both types of samples, H_{ext} shifts the IMT to higher temperatures and makes the transition more gradual. Hall measurements show that in samples with a large IMT, the IMT is almost entirely due to a change in n, whereas in samples with a small IMT, the IMT is due to comparable changes in both n and μ. Near room temperature, the Hall coefficient is H-independent in the nonactivated sample, but decreases substantially with H in the activated samples. In both types of samples, the Hall mobility at 298°K increases by ~25% when a magnetic field

of 140 kOe is applied. This indicates that spin–disorder scattering is one of the main causes for the zero-field resistivity at room temperature. The various data are compared with earlier measurements and are also discussed in terms of current theoretical models. (18 figures, 43 references) (auth)

18839 EuO. II. Dependence of the Insulator–Metal Transition on Magnetic Order. Shapira, Y. (Massachusetts Inst. of Tech., Cambridge); Foner, S.; Aggarwal, R. L.; Reed, T. B. Phys. Rev., B; 8: No. 5, 2316-2326(1 Sep 1973).

Three previously considered relations for the dependence of the activation energy Δ on magnetic order, in "activated" EuO samples, are tested. These relations are: (i) $\Delta = \Delta_0 - (1 + \alpha)\delta_R$, where $\Delta_0 \equiv \Delta(T \gg T_C, H = 0)$, δ_R is the red shift of the optical absorption edge due to magnetic order, and α is a constant; (ii) $\Delta = \Delta_0(1 - \alpha\,\sigma)$, where σ is the reduced magnetization and α is a constant; (iii) $\Delta = \Delta_0(1 - b\,\eta)$, where η is the nearest-neighbor two-spin correlation function and b is a constant. The resistivity and Hall data in the preceding paper, and additional Hall data, are analyzed in detail and compared with these relations. New high-field magnetization and optical red-shift data are presented and used in this comparison. The analysis includes the H dependence of the Hall coefficient at $T \gg T_C$, which is sensitive to the dependence of Δ on magnetic order. It is shown that neither relation (ii) nor relation (iii) represents the data accurately. Penney, Shafer, and Torrance proposed relation (ii) on the basis of more limited data. Relation (i) was tested only at 297°K. At this temperature, relation (i) agreed with the H dependence of the Hall coefficient. More extensive measurements of $\delta_R(H,T)$ and further analysis are necessary to test the validity of relation (i). (12 figures) (auth)

18840 MATERIALS AND PROCESSES FOR THE 70's. Cost Effectiveness and Reliability. 5th National SAMPE Technical Conference, Kiamesha Lake, New York, October 9–11, 1973. National SAMPE Technical Conference Series. Volume 5. Azusa, CA; Society for the Advancement of Material and Process Engineering (1973). 748p. (CONF-731047-). $35.65.

Papers presented at the conference are grouped for presentation in sessions on composite materials, fabrication of metallic components, adhesives and sealants, brazing and diffusion bonding, cost of materials and processes, and metallurgical technology. (JRD)

18841 SVOISTVA SPLAVOV SISTEMY KARBID VOL'FRAMA–KARBID TITANA–KARBID TANTALA–KARBID NIOBIYA–KOBAL'T. (Properties of Alloys in the WC–TiC–TaC–NbC–Co System). Tumanov, V. I. Moscow; Metallurgiya (1973). 184p.

Experimental data of Soviet and foreign authors on the properties of alloys of the subject system are systematized. Data are reported on the mechanical, physical, and chemical properties of alloys in a wide range of variations of the connecting and carbide phases and the grain dimensions of the carbide compounds. In the majority of cases the data are given on the properties of alloys at elevated temperature. The conditions for carrying out tests are indicated. (98 references) (tr-auth)

18842 CRYSTALLOCHEMICAL AND DIELECTRIC SURVEY OF PHASES IN THE TiO_2–ZrO_2 SYSTEM PREPARED BY COPRECIPITATION. Solacolu, S.; Barbulescu, A. (Polytechnical Inst., Bucharest). Rev. Roum. Chim.; 18: No. 11, 1867-1873 (Nov 1973).

Phase formation in the TiO_2–ZrO_2 system was examined starting from noncrystalline powder mixtures prepared by coprecipitation. Results of thermal analysis and data on phase composition prove that, under conditions of coprecipitation, the criterion of the minimum free energy governs the phase direct formation, in agreement with the thermal equilibrium relations. The phases obtained are characterized by a certain nonequilibrium state, which significantly influences the dielectric properties. (auth)

18843 Ni + ThO_2: DISPERSION STRENGTHENED NICKEL. Cyunczyk, A. Rudy Metale Niezelaz.; 18: No. 11, 520-524(1973). (In Polish).

Production methods for obtaining nickel dispersion strengthened with thorium oxide are discussed together with the physical and mechanical properties. Particular attention is given to TD-nickel which is suitable for use at temperatures up to 1300°C. This material has found application in engineering to replace superalloys based on nickel and cobalt matrices. (auth)

Metals and Alloys

Refer also to abstracts 18789, 18790, 18840, 20080, 20536, 20538, 20541, 20545, 20550–20553, 20555, 20557, 20561, and 20578.

18844 STANDARD METHOD OF TEST FOR HYDROGEN LOSS OF Cu, W, AND Fe POWDERS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-E-159-68).

Hydrogen loss of Cu and Fe powders in the range 0.5 to 3.0% and of W powder in the range from 0.01 to 0.5% is covered. Requirements are included for apparatus and reagents, sampling, analytical procedure, and calculations. (JRD)

18845 MISCELLANEOUS USES OF RE MATERIALS (CERAMICS, GLASSES, NUCLEAR APPLICATIONS ETC.). Gschneider, K. S. Jr. (Ames Lab., IA). pp 271-280 of Analysis and Application of Rare Earth Materials. Michelsen, O. B. (ed.). Oslo; Universitetsforlaget (1973).

Following discussion of the uses of RE materials in ceramics and glasses, their use in the nuclear field is discussed. Their major use here is as control rod materials and burnable poisons. The advantage of Eu and Dy as control rod material is that they form successive large cross-section isotopes. Gd and Sm on the other hand are attractive in shutdown and safety devices. Eu must be used in control rods in the trivalent state as the formation of Gd daughters could otherwise lead to a 30% volume contraction. Other applications are as fuel diluents, neutron radiography imaging devices, and as radioisotopes. (INIS)

Corrosion and Erosion

Refer also to abstracts 20101, 20279, 20485, 20554, and 20562.

18846 (N-73-29525) ROLE OF Hf AND Zr IN THE HYDROGEN EMBRITTLEMENT OF Ta AND Nb ALLOYS. Stephens, J. R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 13p. (NASA-TM-X-68293). NTIS $3.00.

The hydrogen embrittlement of aged T-111 and similar Ta and Nb alloys is characterized and the mechanisms believed responsible for the increased sensitivity of T-111 to low-temperature hydrogen embrittlement after aging for 1000 hours or longer near 1040°C are described. A total of eight Ta-base alloys and two Nb-base alloys were investigated. The effects of pre-age annealing temperature, aging time, temperature and environment, and alloy composition on the susceptibility to hydrogen embrittlement were investigated. The primary method of determining the effects of these variables on the ductility of T-111 was by bend testing at 25 and –196°C. Fractured specimens were examined by the scanning electron microscope, electron microprobe, metallography, and x-ray diffraction. (auth)

18847 (N-73-29530) COATED COLUMBIUM THERMAL PROTECTION SYSTEMS: AN ASSESSMENT OF TECHNOLOGICAL READINESS. Levine, S. R.; Grisaffe, S. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 39p. (NASA-TM-X-2858; E-7353). NTIS $3.00.

Evaluation and development to date show that of the coated niobium alloys FS-85 coated with R512E shows significant promise for a reusable thermal protection system (TPS) as judged by environmental resistance and the retention of mechanical properties and structural integrity of panels upon repeated reentry simulation. Production of the alloy, the coating, and full-sized TPS panels is well within current manufacturing technology. Small defects which arise from impact damage or from local coating breakdown do not appear to have serious immediate consequences in the use environment anticipated for the space shuttle orbiter TPS. (auth)

18848 (ORO-4052-8) RELATIONSHIP OF NITROGEN CONTENT TO THE SUSCEPTIBILITY OF AUSTENITIC STAINLESS STEELS TO STRESS CORROSION. Final Technical Report. Clevinger, G. S.; Maitra, S.; Narayanan, R.; Lytton, J. L. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Div. of Minerals Engineering). Aug 1973. Contract AT(40-1)-4052. 172p. Dep. NTIS $10.75.

The effect of solute nitrogen on stress-corrosion cracking of austenitic stainless steels in boiling $MgCl_2$ was investigated in three separate ways: (1) determination of the effect of nitrogen on failure times for Type 304 stainless steel wires for various known stresses, (2) study of U-bend cracking behavior of high purity 20Cr–20Ni and commercial Type 310 alloy, and (3) use of scanning and transmission electron microscopy to determine the effect of nitrogen on the dislocation structure and cracking behavior of Type 304 U-bend specimens. (JRD)

18849 (RFP-2033) CORROSION AND STRESS-CORROSION CRACKING OF WELDED URANIUM-6 WEIGHT PERCENT NIOBIUM. Macki, J. M.; Kochen, R. L. (Dow Chemical U. S. A.,

Golden, Colo. Rocky Flats Div.). 27 Dec 1973. Contract AT(29-1)-1106. 17p. Dep. NTIS $4.00.

The resistance of corrosion and stress-corrosion cracking of welded U–6 wt % Nb in oxygen-saturated water containing 50 ppM chloride ions was investigated. The tests showed that a post-weld heat treatment consisting of solution quenching and underaging (350°C for 42 min) provided the best resistance to corrosion and pitting corrosion. Although selective corrosion and pitting corrosion were observed on many of the specimens tested, no evidence of stress-corrosion cracking was found. (auth)

18850 (UCRL-12290) IGNITION AND OXIDATION BEHAVIOR OF F-48 COLUMBIUM ALLOY. Robinson, E. Y.; Wells, W. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1965. Contract W-7405-eng-48. 54p. Dep. NTIS $4.75.

Declassified 26 Nov 1973.

Axial tie rod base blocks used to support the Tory II-C reactor were tested for oxidation and ignition at 2450°F. The blocks are made of F-48 Nb alloy coated with a silicide. Test data are discussed and predicted operational behavior is summarized. (JRD)

18851 EFFECT OF ADDITIVE CALCIUM ON RATE OF INTERNAL OXIDATION OF SILVER–CADMIUM ALLOYS. Shen, Y. S.; Krock, R. H. (P. R. Mallory and Co., Inc., Burlington, MA). Met. Trans.; 5: No. 1, 312-315(Jan 1974).

Studies of Ag–Cd internal oxidation revealed that in addition to other controlling factors, the oxidation rate can be increased by introducing additive Ca in amounts of about 0.1 wt %. The mechanism by which the oxidation rate of Ag–Cd alloys is enhanced by Ca additives can be associated with the effects of Ca diffusion rates, and the effect of Ca on nucleation rates for precipitation. (JRD)

18852 HYDROGEN EVOLUTION REACTION ON VANADIUM, CHROMIUM, MANGANESE, COBALT. Belanger, A. (Univ. of Quebec, Varennes); Vijh, A. K. J. Electrochem. Soc.; 121: No. 2, 225-230(Feb 1974).

The electrolytic hydrogen evolution reaction (HER) was studied on V, Cr, Mn, and Co in sulfuric acid–sulfate solutions. The data consist of Tafel slopes, exchange current densities, apparent heats of activation, corrosion rates, corrosion potentials, and, in some cases, reaction order derivatives. Attempts were also made to obtain information on the electrode coverage by transient techniques. The presence of corrosion, however, makes the possible electrode coverage by adsorbed hydrogen inaccessible. By combining these electrode kinetic data with the gas-phase hydrogen adsorption behavior of these metals, it is suggested that the HER proceeds by means of the initial discharge mechanism on V and Mn whereas on Cr and Co, the radical-ion mechanism has been concluded. (auth)

18853 ELLIPSOMETRIC STUDY OF THE PLASMA OXIDATION OF TANTALUM. Leslie, J. D. (Centre de Recherches sur les Tres Basses Temperatures, Grenoble, France); Knorr, K. J. Electrochem. Soc.; 121: No. 2, 263-267(Feb 1974).

It is shown that it is possible to grow a uniform Ta oxide film up to a thickness of 1500 Å by plasma oxidation. The average speed of growth was 0.1 Å/s, which is comparable to earlier studies. There is no significant contamination of the oxide due to sputtering from the cathode and there is no evidence of sputter etching of the sample oxide due to the sample facing the cathode. These results are in opposition to earlier investigations. Ellipsometric measurements on the oxide growth indicate that the Ta oxide being formed is a single, uniform layer with an index of refraction of 2.21, in contrast to Lee et al., (ibid., 117: 1172 (1970)) who fitted their ellipsometric measurements on plasma-grown Ta oxide with a two-layer model with layer indices of 1.89 and 2.22. (auth)

18854 HIGH-TEMPERATURE OXIDATION OF TUNGSTEN WIRES IN CO_2–Ar MIXTURES. Harvey, F. J. (Westinghouse Research Labs., Pittsburgh). Met. Trans.; 5: No. 1, 35-38 (Jan 1974).

The oxidation kinetics of tungsten wires in natural convection has been investigated in CO_2–argon mixtures in the temperature range between 2450 and 3000°K and the CO_2 partial pressure range between 2.13×10^{-6} to 1.28×10^{-4} atm at 0.789 atm total pressure. The rate generally decreases with increasing temperature at constant bulk CO_2 pressure with a magnitude ranging between 0.5 to 5×10^{-4} g/cm² s. The oxidation reaction is gas transport controlled as demonstrated by supplemental measurements at 0.395 atm total pressure. A volatile oxide counter diffusion model, which has been previously proposed to explain the oxidation kinetics of tungsten wires in O_2–argon mixtures, is in reasonable agreement with the data. (auth)

18855 CORROSION OF SOME Zr ALLOYS UNDER RADIATION IN MOIST CO_2–AIR MIXTURES. Asher, R. C.; Davies, D.; Kirstein, T. B. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 49: No. 2, 189-196(Dec 1973).

In-reactor experiments are reported in which Zircaloy-2 and Zr–2½ wt % Nb alloys were exposed to moist carbon dioxide–air mixtures at 300°C for periods up to ≈ 800 days. For Zircaloy-2, the corrosion was significantly enhanced by the reactor radiation, but the percentage hydrogen pickup was reduced. For Zr–2½ wt % Nb alloy the effect of radiation on the corrosion rate ranged from a slight suppression to a significant enhancement, depending on the metallurgical condition of the alloy, but there appeared to be no effect on the percentage hydrogen pickup. The effect of improving the purity of the corrodent was also studied in the absence of radiation. Results are used to predict that the corrosion and hydrogen pickup of typical reactor pressure tubes exposed to moist carbon dioxide–air mixtures are unlikely to cause a significant deterioration of their mechanical properties. (12 figures) (auth)

18856 STANDARD RECOMMENDED PRACTICE FOR AQUEOUS CORROSION TESTING OF SAMPLES OF Zr AND Zr ALLOYS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-G-2-67).

The practice presented is for quality control, inspection, and quality improvement of Zr and Zr alloys. Requirements are included for test equipment, specimen cleaning, inspection, corrosion testing, and control specimens. (JRD)

18857 SILICIDE COATINGS ON MOLYBDENUM OBTAINED BY ELECTROTRANSPORT AND DIFFUSION FROM MOLTEN FLUORIDES. Petrescu, N.; Petrescu, M.; Britchi, M.; Pavel, L. (Center of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 18: No. 11, 1853-1858(Nov 1973).

Experimental researches were performed for obtaining high-temperature oxidation-resisting silicide coatings on molybdenum. The treatment was carried in molten fluoride electrolytic baths from which silicon was cathodically deposited on molybdenum under conditions that favored its diffusion in the base metal. Optical microscopic information was obtained about the diffused layer thickness as function of the current density, and about the structure of the layer. The nature of the coating layer was established by x-ray diffraction analysis and by microprobe analysis (x-ray images and quantitative analysis by direct emission x-ray spectroscopy). The obtained coating layers were compact and uniform, perfectly coherent with the base metal, with constant silicon content on their whole thickness, and were identified as consisting of $MoSi_2$, a compound which imparts to molybdenum a very good resistance to high-temperature oxidation. (auth)

18858 POLUCHENIE POKRYTIL VYSOKO-TEMPERATURNYM RASPYLENIEM. (Preparation of Coatings by High-Temperature Sputtering). Druzhinina, L. K.; Kudinova, V. V. Moscow; Atomizdat (1973). 312p.

The papers presented at the conference and some articles written especially for this collection are compiled. Data are presented on the different methods for the deposition of coatings using electric arcs, acetylene–oxygen flames and plasmas, and equipment used in these procedures. Information is presented on the increased use of coatings. The results of experimental studies on the properties of coatings of metallic and ceramic materials as a function of deposition conditions, composition of the gaseous atmosphere, composition of the deposited material, and other factors are given. Among the coatings discussed are W, WC, Mo, Nb, Ta, and Ti. Questions on the physicochemical interaction of coatings with the backing ensuring obtaining a satisfactory bonding are examined. The quality control of the coatings is considered. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 20548 and 20558.

18859 (REG/G-1.50(5-73)) CONTROL OF PREHEAT TEMPERATURE FOR WELDING OF LOW-ALLOY STEEL. (USAEC Directorate of Regulatory Standards, Washington, D. C.). May 1973. 2p. DRS.

The guide directs that weld fabrication for low-alloy steel components should comply with the fabrication requirements specified in Section III and Section IX of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code as supplemented by the following points. 1. The procedure qualification should require that: a. A minimum preheat and a maximum interpass temperature be specified. b. The welding procedure be qualified at the minimum preheat temperature. 2. For production welds, the preheat temperature should be maintained until a post-weld heat treatment

has been performed. 3. Production welding should be monitored to verify that the limits on preheat and interpass temperatures are maintained. 4. In the event that regulatory positions C.1., C.2. and C.3. above are not met, the weld is subject to rejection. However, the soundness of the weld may be verified by an acceptable examination procedure. (JRD)

18860 CHEMICALLY VAPOR DEPOSITED TUNGSTEN FOR SEMICONDUCTOR METALLIZATIONS. Melliar-Smith, C. M.; Adams, A. C.; Kaiser, R. H.; Kushner, R. A. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Electrochem. Soc.; 121: No. 2, 298-303(Feb 1974).

The properties of CVD tungsten films, produced by hydrogen reduction of WF_6 or WCl_6, were investigated to determine the suitability of the films for use as silicon integrated circuit metallizations. Both low pressure and atmospheric pressure flow systems were investigated. The tungsten films show excellent adhesion to silicon substrates, have resistivities between 6 and 15 μohm-cm depending on thickness, and are easily etched into submicron patterns. In addition, the contact resistance to silicon and MOS properties of tungsten films from both deposition reactions were measured. (8 figures) (auth)

18861 EFFECT OF SOLDERING PARAMETERS ON PROPERTIES OF SOLDERED Kh15N9Yu STEEL JOINT. Radzievskii, V. N.; Lotsmanov, S. N.; Sosnovovskii, L. A.; Rymar, V. I. Svar. Proizv.; No. 2, 40-41(Feb 1973). (In Russian).

Optimum conditions for the soldering of Kh15N9Y steel with the solder PZhk-1000 were established: T_p = 1245 to 1250°C, holding time of 3 min, and vacuum no less than 1×10^{-4} mm Hg. Uncoordinated change of B_γ and B_{-1} appeared during change of the width of the solder joint: with its increase B_γ remains constant but B_{-1} is substantially altered, which can be explained by the coarse-grained texture of the structure of the metal of the solder joint. The basic parameter most sensitive to change is the specific viscosity. A decrease of the clearance, impairment of the vacuum, increase of the temperature, and lengthening of the duration of the soldering process leads to a substantial decrease of the viscosity of the soldering compound. (tr-auth)

18862 REACTION OF ALUMINUM TITANATE CRUCIBLES WITH MOLTEN URANIUM. Holcombe, C. E.; Powell, G. L. (Union Carbide Corp., Oak Ridge, TN). J. Nucl. Mater.; 49: No. 2, 238-240(Dec 1973).

Melting experiments were conducted at 1140 to 1250°C for 5 to 45 min in β-Al_2TiO_5-coated Ti crucibles. The U pellets, which originally contained 10 ppM Al and 0.2 ppM Ti, were found to pick up 50 to 100 ppM Al and Ti. The black ALT coating had no spalling or cracking, but a brown UO_2 film was formed. Scanning electron microscopy was carried out on the interface. The reduction of ALT by U and the reasons for its slow rate are discussed. (DLC)

18863 STANDARD RECOMMENDED PRACTICE FOR PREPARATION OF W AND W ALLOYS FOR ELECTROPLATING. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-B-482-68).

A specification is presented for electroplating on W and W alloy substrates. Recommended practices are included for processes classified as providing as-deposited adhesion of the coating, and adhesion of the coating depending on diffusion. (JRD)

18864 PREPARATION OF TARGETS OF Ca, Ba, Fe, La, Pb, Tl, Bi, Th, AND U BY ELECTRODEPOSITION FROM ORGANIC SOLUTIONS. Aumann, D. C.; Muellen, G. (Technische Univ., Munich). Nucl. Instrum. Methods; 115: No. 1, 75-81(1974).

The preparation of thin and thick films of Ca, Ba, Fe, La, Pb, Tl, Bi, Th and U by electrodeposition from organic solutions is described. Experience has shown that three experimental conditions were favorable for producing uniform and adhering films: (1) the use of only 1 to 2 ml of the organic solvent, (2) the use of relatively high current densities (2-6 mA/cm^2), and (3) not more than 100 $\mu g/cm^2$ of the elements should be deposited at a time. Thicker layers are produced by repeating the electrodeposition after heating the backing with the layer. (auth)

18865 SELF-SUPPORTING TANTALUM NITRIDE TARGET FOILS. Fulbright, H. W.; Freiesleben, H. (Univ. of Rochester, NY). Nucl. Instrum. Methods; 115: No. 1, 83-84(1974).

A method of preparing self-supporting tantalum nitride foils of high purity suitable for use as ^{14}N and ^{15}N targets in nuclear reaction experiments is described. (auth)

18866 SIMPLE CELL AND TECHNIQUE FOR THE ELECTRODEPOSITION OF RADIONUCLIDES ON A STAINLESS-STEEL BACKING. Joshi, S. R.; Roy, J. C. (Univ., Laval, Quebec). Nucl. Instrum. Methods; 115: No. 1, 303-305(1974).

A simple electrochemical technique for the preparation of adherent deposits on a stainless-steel backing has been developed. It is based on the use of a chromatographic paper, impregnated with electrolyte, to separate the two electrodes. Electrode-position is achieved from a solution having a volume of only 0.15 to 0.25 ml. The technique has been applied to the preparation of ^{233}U and ^{241}Am radioactive sources. Results with ^{65}Zn, ^{147}Pm and ^{160}Tb are also given. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 18110, 18788, 18815, 18828, 19362, 19757, 20006, 20182, 20187, 20190, 20547, and 20549.

18867 (AECL-4652) PRELIMINARY STUDY OF CAST AND TRANSFORMED MICROSTRUCTURES OF Zr_3Al-BASED ALLOYS. Schulson, E. M. (Atomic Energy of Canada Ltd., Chalk River Nuclear Labs.). Dec 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75. AECL $1.00.

The microstructures of an arc-cast and transformed Zr–8.8 wt. % Al alloy were studied using optical and scanning electron microscopy. Hardness and length-change measurements were also made. The cast structures consist of a composite mixture of two phases, a Zr(Al) solid-solution matrix and Zr_3Al. In the rapidly cooled parts of the casting the scale of the structure is of the order of 1 to 2 μm, whereas in the more slowly cooled parts it is of the order of 8 to 10 μm. The macrohardness is 414 ± 7 Vickers hardness number. The structures are believed to be either eutectic or cellular in origin, the former appearing to be the more probable. The presence of Zr_3Al suggests that the peritectoid reaction $Zr_2Al_3 + Zr \rightarrow 3Zr_2Al$ goes essentially to completion as the alloy is cooled through the solid state. Evidence is presented which confirms that Zr_3Al is produced via two peritectoid reactions: $Zr_2Al_3 + Zr \rightarrow 3Zr_2Al$ and $Zr_2Al + Zr \rightarrow Zr_3Al$. The growth is shown to be thermally activated, and this leads to an expression relating the total production rate of Zr_3Al to the cube root of the number of Zr_3Al particles of eutectic branches per unit volume; i.e., $R \propto N^{\frac{1}{3}}$. The velocity of the latter reaction appears to maximize at about 875°C; i.e. at approximately 100°C below the equilibrium peritectoid temperature. This effect is explained briefly on the basis of nucleation and growth theory. The alloy hardness decreases by ~40% as the structure transforms the as-cast, composite mixture to Zr_3Al. About 80% of this change occurs within the first few hours at 900°C, suggesting that the velocity of the second reaction is fairly rapid and is accompanied by a length change of ~0.6%. This corresponds to a volume contraction of 1.8% which agrees with that calculated on the basis of the different densities and the proportions of each phase. (auth)

18868 (CEA-R-4522) STUDY OF THE SIZE EFFECT BY ACCURATELY DETERMINING THE CRYSTAL PARAMETERS. Seguin, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). Feb 1974. 73p. (In French). Dep. NTIS (U.S. Sales Only) $5.75.

Thesis. Submitted to Nancy Univ. (France).

The size factor $\eta = da/ad\ C$ was measured by comparing the variations in the crystal parameter as a function of the concentration, samples of Al of various degrees of purity and Al–V and Al–Cu alloys with concentrations of less than 1000 ppM being used. The results confirm the experimental results obtained with alloys supersaturated by ultrarapid tempering but are not consistent with theoretical values, which appear to be too large for the case of transition elements in solution in Al. The parameter was determined from Kossel diagrams obtained using an electron-probe microanalyzer. The measurement methods were developed and generalized by plotting curves representing the variation of the parameter as a function of temperature between 20 and 60°C. Values were obtained for the parameter at given temperatures (±0.1°C) with an accuracy of $Aa/a \simeq 8.10^{-6}$. (auth)

18869 (CNLM-2693) SUMMARY REPORT OF AGING STUDIES IN AN ALLOY OF NIOBIUM WITH ONE PERCENT ZIRCONIUM. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 8 Jun 1960. 15p. Dep. NTIS $3.00.

Declassified 19 Sep 1973.

Extensive studies of a Nb–1 Zr alloy have shown that aging effects are encountered in the temperature range 1500 to 1700°F following annealing in the temperature range 2900 to 3200°F. These aging effects were reflected by hardness increase, short-time tensile strength increase, and reduction of tensile ductility. Similarly, welded specimens exhibited loss of bend ductility when aged between 1500 and 1700°F in the as-welded condition. Structural changes, accompanying the aging effects, were analyzed by electron microscopy, electron diffraction, and electron microprobe

techniques. In no case were the observed aging effects of sufficient magnitude to compromise design safety factors. Moreover, annealing at 2200°F, prior to lower temperature exposure, eliminated all aging effects in both base metal and welds. There was good agreement in data developed by Pratt & Whitney Aircraft and Oak Ridge National Laboratory. The apparent discrepancy in earlier results reported by both laboratories was resolved. The earlier data were based upon different melts of alloy that exhibited different aging characteristics. (auth)

18870 (COO-2037-18) ELECTROMIGRATION IN METALLIC SYSTEMS. Rigney, D. A. (Ohio State Univ., Columbus (USA)). 29 May 1973. 73p. (CONF-730554-3). Dep. NTIS $5.75.

From meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers; Philadelphia, Pennsylvania, USA (29 May 1973).

The more likely contributions to electromigration in metallic single crystals and polycrystals are briefly discussed. These include such factors as driving force, diffusion, and local binding energy. The driving force is particularly emphasized, especially in liquid alloys. Such systems are thought to be simpler than the corresponding solid alloys, which present complications due to the details of crystalline and defect structure. A simple scattering approach is described and applied to selected liquid alloy systems. Implications for controlling electromigration in such practical devices as those based on thin film circuits are considered. (5 tables, 19 figures, 122 references) (auth)

18871 (JAPFNR-125) RESPONSE OF STRUCTURAL MATERIALS TO IMPULSIVE LOADING FOR FAST BREEDER REACTOR DEVELOPMENT. Fujimura, T.; Ueda, S.; Oba, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1970. 55p. Dep. NTIS (U. S. Sales Only) $4.75.

For Power Reactor and Nuclear Fuel Development Corp., Tokyo.

In order to evaluate nuclear accidents of fast breeder reactors, shock-structure tests were carried out by various organizations on the test models. In the evaluation of the response of the model to such shock-structure test, the behavior of materials subjected to high-speed deformation is an important aspect. An impulsive tension apparatus of Austin type was manufactured and its performance, together with the mechanical properties of SUS27 steel, SS41 steel, bolt steel, and ultrahigh-tension steel was tested to obtain the effect of strain rate on the mechanical properties of materials used for fast breeder reactor including yield strength, tensile strength, elongation, and reduction of area. (auth)

18872 (JUL-962-FF) RELAXATION STRENGTH OF THE SNOEK EFFECTS OF HYDROGEN IN VANADIUM, NIOBIUM, AND TANTALUM. Buchholz, J. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). Jun 1973. 111p. (In German). Dep. NTIS (U.S. Sales Only) $7.75.

Thesis. Submitted to Technische Hochschule, Aachen.

A new method was used based on measuring of elastic constants as a function of the temperature in the temperature region above the damping maximum of torsional oscillations. The Snoek relaxation should be noticeable in this region ($\omega \tau \ll 1$) in a change of the absolute value and as a result of the $1/T$ dependence on the relaxation intensity, and also as change of the temperature dependence. The torsion modulus of hydrogen-charged monocrystalline samples of Ta, Nb, and V in the [111] and [100] directions was carried out in a temperature range from room temperature to 150°C. The observed change of the absolute value of the modulus as a function of the hydrogen concentration was two to three orders of magnitude smaller than expected by comparison with N, O, and C. No paraelastic part with a $1/T$ temperature dependence could be seen. From both observations, the upper limits for the difference A−B of the dipole tensor components could be determined: Ta−H: < 0.21 eV; Nb−H: < 0.11 eV; V−H: < 0.09 eV. These values, normed A + 2B, are a factor of 10 to 30 times smaller for N, O, or C in these metals. The distortional field of hydrogen and its isotopes is thus essentially of cubic symmetry, although the arrangement of the nearest neighbors of the interstitials exhibits tetragonal symmetry. (GE)

18873 (N-73-27580) SHIELD MATERIALS RECOMMENDED FOR SPACE POWER NUCLEAR REACTORS. Kaszubinski, L. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 36p. (NASA-TM-X-2835; E-7347). NTIS $3.00.

Lithium hydride is recommended for neutron attenuation and depleted uranium is recommended for gamma-ray attenuation. For minimum shield weights these materials must be arranged in alternate layers to attenuate the secondary gamma rays efficiently. In the regions of the shield near the reactor, where excessive fissioning occurs in the uranium, a tungsten alloy is used instead. Alloys of uranium such as either the U−0.5Ti or U−8Mo are available to accommodate structural requirements. The zone-cooled casting process is recommended for lithium hydride fabrication. Internal honeycomb reinforcement to control cracks in the lithium hydride is recommended. (auth)

18874 (ORNL-4936) MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS. Quarterly Progress Report for Period Ending October 31, 1973. Hill, M. R. (comp.) (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 220p. AT.

Research on structural materials for reactors and power plants is summarized. Activities in programs at Aerojet Nuclear Company, Argonne National Laboratory, Naval Research Laboratory, Oak Ridge National Laboratory, and Westinghouse Advanced Reactors Division are described. (JRD)

18875 (RFP-2115) ANALYSIS OF HIGH-DENSITY AREAS IN BERYLLIUM HEMISHELLS. Lee, O. A.; Riefenberg, D. H.; (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 17 Jan 1974. Contract AT(29-1)-1106. 6p. Dep. NTIS $4.00.

Small areas of high and low radiographic density in hot-pressed beryllium were studied by macroetching and optical and electron microscopy. The areas were either semispherical or wormlike in shape and were found to be agglomerates of grains markedly coarser or finer than the matrix. (auth)

18876 PREPARATION AND CHARACTERIZATION OF BETA-W, A METASTABLE TUNGSTEN PHASE. Morcom, W. R. (Westinghouse Lamp Div., Bloomfield, NJ); Worrell, W. L.; Sell, H. G.; Kaplan, H. I. Met. Trans.; 5: No. 1, 155-161 (Jan 1974).

A metastable phase of tungsten (β-W) is obtained by hydrogen reduction of WO_3 at 500°C. Five different samples of WO_3 have been used to investigate the effects of oxide surface area and impurity content on the reduction process. The initial oxide samples and the reduction product have been characterized by scanning electron micrographs, and measurements of the oxygen content of β-W have been performed. It is concluded that β-W is not a suboxide as previously reported by Hägg and Schönberg. The effect of other elements on the β-W to α-W transformation temperature has been investigated. (auth)

18877 DEFORMATION BEHAVIOR AND TEXTURE DEVELOPMENT IN BETA Ti−V ALLOYS. Ling, F. W.; Starke, E. A. Jr.; Lefevre, B. G. (Georgia Inst. of Tech., Atlanta). Met. Trans.; 5: No. 1, 179-187(Jan 1974).

Beta-phase titanium−vanadium alloys in the composition range 20 to 40 wt % vanadium were studied to determine the dependence of mechanical properties and texture formation on deformation modes. Changes in twinning probability and slip characteristics with vanadium content are reflected in wide variations in sheet textures in both as-rolled and rolled and recrystallized samples. These sheet textures exhibit strongly anisotropic strength properties which may be qualitatively related to the type of texture. (auth)

18878 OBSERVATIONS ON MICROSTRUCTURE AND ORIENTATION RELATIONS IN V−H SYSTEM. Wanagel, J.; Sass, S. L.; Batterman, B. W. (Cornell Univ., Ithaca, NY). Met. Trans.; 5: No. 1, 105-109(Jan 1974).

Observations on the microstructure and orientation relations in the V−H system were made using optical, x-ray, and electron-microscopy techniques. In the two-phase $\alpha + \beta$ region the axes of the β(bct) vanadium hydride were shown to be slightly tilted away from the cube axes of the α(bcc) vanadium. Metallographic observations of a polished (100) crystal showed two different surface features associated with the formation of the β hydride depending on the concentration. In the two-phase $\beta + \gamma$ region the orientation relation between the β(bct) phase and the γ(fcc) phase is such that the $(100)_\beta \parallel (110)_\gamma$ and $[001]_\beta \parallel [001]_\gamma$. (auth)

18879 FORMATION OF MODULATED STRUCTURES IN Ni−V ALLOYS. Moreen, H. A. (Rockwell International, Anaheim, CA); Taggart, R.; Polonis, D. H. Met. Trans.; 5: No. 1, 79-90(Jan 1974).

The precipitation of the ordered Ni_3V phase in binary Ni−V alloys has been studied by employing transmission electron microscopy, x-ray analysis, electrical resistivity, and mechanical property measurements. The reaction consists of two stages, the first of which involves the formation of domain wave composition modulations manifested by a tweed microstructure and an accompanying strain field. The second stage is an amplification of the long-range order waves and is manifested by the formation of the ordered Ni_3V phase. The strain fields produced by the domain waves interact with the strain field of the Ni_3V nuclei leading to the formation of a single variant of tetragonal Ni_3V in a given region of the matrix. The strength of the continuously ordered alloys is controlled by the strain in the lattice in agreement with the Mott and Nabarro theory of strengthening. (auth)

18880 KINETICS OF SOLID V–N_2 REACTIONS AT HIGH TEMPERATURES. Muije, P. (Georgia Inst. of Tech., Atlanta); Horton, R. M.; Duran, S. A. Met. Trans.; 5: No. 1, 97-104 (Jan 1974).

Thermogravimetric studies were made to determine the kinetics of the reaction between 99.83% vanadium sheet and purified nitrogen gas in the temperature range of 1173 to 1723°K, at pressures of 9.3×10^4 to 9.3 Pa (700 to 7×10^{-2} torr) and times up to 160 h. Metallographic and x-ray-diffraction techniques were used to examine the reaction products. The data followed either parabolic, cubic, or linear kinetics. In general, it was observed that the initial kinetics were parabolic. At high temperatures and near atmospheric pressures, the reaction kinetics changed from parabolic to cubic at longer times. At the lowest pressure the preparabolic kinetics were linear. Weight gains in the parabolic region were mainly due to solution and diffusion of nitrogen in vanadium with the weight gain shown by the equation $(\Delta W/A)^2 = 3.2 \times 10^{-4}\ Te^{-182{,}000/RT}t$. The cubic region was related to the formation of an outer layer of VN over an intermediate layer of V_2N and a core of the saturated solution of nitrogen in vanadium with the approximate weight gain shown by the equation $(\Delta W/A)^3 = 1.24 \times 10^{-3}\ Te^{-208{,}000/RT}t$. Linear weight gains at low pressure were presumed to be controlled by the rate of nitrogen absorption. (auth)

18881 MAGNETIC AND CRYSTAL STRUCTURE OF Tb–LIGHT RARE EARTH ALLOYS. Achiwa, N.; Kawano, S. (Kyoto Univ.). J. Phys. Soc. Jap.; 35: No. 1, 303(Jul 1973).

In order to investigate the relation between magnetic and crystal structure, neutron-diffraction studies on single crystals of Sm-type Tb_1-La_1, Tb_1-Pr_1 and Tb_3-Nd_1 and hcp-type Tb_1-Pr_1 and Tb_3-Nd_1 were carried out. For all the Sm-type crystals, below the Néel temperatures there are two magnetic satellites around each reciprocal lattice points from which the satellites are displaced by the vector $\pm 1.5c^*$. Each plane of hexagonal sites forms a ferromagnetic sheet in the c-plane with the moments parallel to the sheet. (JRD)

18882 RECRYSTALLIZATION AND X-RAY DIFFRACTION INVESTIGATION OF AGE-HARDENING IN A METASTABLE Ti–13V–11Cr–3Al ALLOY. Seilstorfer, H. (Messerschmitt–Boelkow–Blohm GmbH, Munich). Z. Metallk.; 64: No. 9, 618-625(1973). (In German).

Three recrystallization diagrams for the metastable titanium alloy, Ti–13V–11Cr–3Al, were established, based on grain size determinations. Qualitative as well as quantitative phase and lattice parameter measurements were made using x-ray diffraction techniques. The lattice parameter and hardness values for Ti–13V–11Cr–3Al were plotted as a function of the isothermal aging temperature and time. A minimum value of the lattice parameter was seen to coincide with maximum hardness and maximum α-phase content at 450°C. The presence of the γ-phase was established using a scanning electron microscope. (GE)

18883 SPREADING OF LIQUID TITANIUM AND ZIRCONIUM OVER PYROGRAPHITE. Kostikov, V. I.; Koshelev, Yu. I.; Filimonov, E. F. (Moscow Inst. of Steel and Alloys). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 4, 533-536(Apr 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 4, 592-595(Apr 1973).

The kinetics of liquid Ti and Zr flow over pyrographites with $\sigma_s = 350$ erg/cm² and $\sigma_s = 720$ erg/cm² was investigated. The temperature dependences of the kinetics of liquid titanium flow were obtained. The rate of flow decreases with increasing temperature. The loss of free surface energy and the interphase energy at the boundary between the solid and liquid were calculated from the kinetics of flow. The value of σ_{s-l} obtained from the data on the flow kinetics agrees closely with that obtained by the method of rise of the liquid metal between plane-parallel plates. (auth)

18884 ELECTRONOGRAPHIC STUDY OF THIN INDIUM FILMS CONTACTING WITH SILVER AND GOLD FILMS. Grebennik, I. P.; Tonkopryad, A. G. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 36: No. 3, 524-528(1973). (In Russian).

An electronographic method was used in studying processes occurring in the contact zone between indium and thin silver and gold films. In the two-layer region there was interaction of the indium with the silver and gold, opposing formation of the corresponding phases. Close to the boundary, the indium was dispersed along the surface of the gold and silver films, opposing an outflow in volume. The activation energy of the process of indium dispersion on the silver and gold was 9 and 12 kcal/mole, respectively. (tr-auth)

18885 STRENGTHENING NATURE OF HIGH-SPEED MARAGING STEELS OF IRON–COBALT–TUNGSTEN TYPE. II. Structural and Concentration Changes in Matrix Phase of Steels and Their Influence on Strengthening and Weakening Processes. Gitgarts, M. I.; Susin, A. A. (Inst. of Problems of Reliability and Durability, Minsk). Fiz. Metal. Metalloved.; 36: No. 3, 551-559 (1973). (In Russian).

The precipitation kinetics and structural changes in the solid solution upon aging of Fe–Co–W steels containing 0.06 and 0.27 wt.% C were studied. Dependence of the decay on the C content of the steel was established, as causing a change in the composition of the primary dispersed phases and the cobalt concentration in the solid solution. The structural state of the matrix in the aging of the steel was shown to change as a result of two processes–relaxation of the deformation of the martensite structure and "local" deformation of the lattice due to separation of the highly dispersed iron tungstide particles. The changes in the structural state of the solid solution and the kinetics of separation of the strengthening phase cause the regularity in the hardness changes. (tr-auth)

18886 INFLUENCE OF COBALT ON STRENGTHENING OF MARTENSITE OF IRON–NICKEL–COBALT–TUNGSTEN ALLOYS DURING AGING. Edneral, A. F.; Zhukov, O. P.; Perkas, M. D. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 3, 569-573(1973). (In Russian).

Changes in hardness, electrical conductivity, and mechanical properties occurring during aging of martensitic alloys, Fe–15% Ni–10% W–(0 to 20)% Co were studied. The cobalt was shown to contribute to strengthening of the maraging Fe–Ni–Co–W alloys upon heating; this reaction is related to the amount of W that separates from the solid solution upon aging. In the Fe–Ni–Co–W system a strength of about 270 kg/mm² is achieved with satisfactory indexes of plasticity. (tr-auth)

18887 BRITTLENESS OF RECRYSTALLIZED MOLYBDENUM. Zelenskii, G. K.; Borodich, V. D.; Biryukov, S. I.; Korontsevich, V. K. Fiz. Metal. Metalloved.; 36: No. 3, 622-630(1973). (In Russian).

The plasticity of recrystallized Mo was studied as a function of the C content (4×10^{-3} to 30×10^{-3} wt %) and O content (1×10^{-3} to 9×10^{-3} wt %), grain size, and thermal processing regime. The plasticity was clearly shown to be determined by the O and C concentrations on the grain boundaries. (tr-auth)

18888 X-RAY STUDY OF TUNGSTEN WIRE SUBSTRUCTURE DURING SECONDARY RECRYSTALLIZATION. Kantur, O. V.; Terminasov, Yu. S. (Kuibyshev Polytechnical Inst., USSR). Fiz. Metal. Metalloved.; 36: No. 3, 658-661(1973). (In Russian).

The results of x-ray microscopic studies of secondary recrystallization in W wire showed the steps in the development of the substructure and indicated that crystallites grow by coalescence of subunits. (tr-auth)

18889 STRUCTURE AND PHASE COMPOSITION OF ALLOYS $Pr(Co,Cu)_5$, $Pr(Co,Cu,Fe)_5$, AND $Pr(Co,Ni)_5$. Zakharova, M. I.; Fuentes, Kh. (Moscow State Univ.). Fiz. Metal. Metalloved.; 36: No. 3, 662-664(1973). (In Russian).

The results of x-ray diffraction, optical microscopy, microhardness measurements, and x-ray local spectral analysis showed that, in the system Pr–Co–Cu, there is a solid-solution region based on $Pr(CoCu)_5$. With the addition of Fe in an amount to form $Pr(CoCuFe)_5$, phase transitions were similar. In attempts to replace Co with Ni, the same phase changes were not observed. (tr-auth)

18890 FORMATION OF PLATE-STEM CARBIDE-AUSTENITE COLONIES IN PROCESS OF Fe–W–Cr–V–Mo ALLOY SATURATION WITH CARBON. Bunin, K. P.; Movchan, V. I.; Redan, L. G. (Dnepropetrovsk Metallurgical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 2, 123-126(1973). (In Russian).

The characteristics of the structure formation during carbonization of the Fe–W–Cr–V–Mo alloy with 0.16% C, 7.8% W, 3.3% Cr, 1.5% V, and 0.93% Mo were described. By grinding and microstudy of the same sections the structure of the carbides in the carbide-austenite colonies was represented stereometrically. (tr-auth)

18891 QUADRUPOLE INTERACTION IN HAFNIUM METAL. Zmora, H.; Lowe, L. M.; Prestwich, W. V. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 14, 1505-1507(15 Jul 1973).

The electric quadrupole interaction of ^{181}Ta in Hf metal was measured as a function of the annealing temperatures of the irradiated samples. The asymmetry parameter obtained was $\eta = 0.3$, independent of the thermal history of the samples. (auth)

18892 PHONON DISPERSION RELATIONS AND THERMAL EXPANSION OF ERBIUM. Ramji Rao, R.; Menon, C. S. (Indian Inst. of Tech., Madras). J. Appl. Phys.; 44: No. 9, 3892-3896 (Sep 1973).

The lattice dynamics, second- and third-order elastic constants,

and the temperature variation of the lattice thermal expansion of erbium are worked out on the basis of Keating's method. The ten third-order elastic constants are calculated using four third-order anharmonic parameters. The model used reproduces the measured pressure derivatives of the second-order elastic constants of erbium well. The low- and high-temperature limits $\bar{\gamma}_L$ and $\bar{\gamma}_H$ of the lattice thermal expansion are evaluated and the calculated $\bar{\gamma}_H$ is compared with that obtained from the thermal expansion and specific heat data. The dispersion relations in erbium are found to be similar to those in holmium. (auth)

18893 NATURE OF ENERGY GAP ANISOTOPY IN SUPERCONDUCTING NON-TRANSITION METALS. Zhernov, A. P. Fiz Metal. Metalloved.; 36: No. 3, 462-466(1973). (In Russian).

As factors leading to an angular dependence of the energy gap, $\Delta(k)$, in the non-transition superconducting metals, electron–phonon processes with transfer and the complex shape of dispersion phonon curves were examined. Consideration of these factors made it possible to obtain correct orders of magnitude for extreme values of the gap and measurements of its mean square anisotropy. It was established that the chief role in formation of an angular dependence of the gap is played by processes involving transfer. The $\Delta(k)$ values found were used in determining the temperature dependence of the electron component of the heat capacity. Calculated values of the heat capacity were close to experimental values. (tr-auth)

18894 ELASTIC ENERGY OF WEDGE DISCLINATION LOOPS IN HEXAGONAL CRYSTALS. Chou, T. W.; Pan, Y. C. (Univ. of Delaware, Newark). J. Appl. Phys.; 44: No. 9, 3889-3891(Sep 1973).

The plane of the wedge disclination loop is assumed to be parallel to the basal plane in hexagonal-close-packed crystals. The rotation axis of the loop lies in the basal plane. Closed-form solutions are obtained for the stress field and elastic energy of the disclination loop. Unlike the case of a twist disclination loop, there is a dilatational field associated with a wedge disclination. The strain energies of wedge disclinations are computed for some common hexagonal crystals (C, CdS, Co, H_2O, Mg, Tl, Zr). It is noted that for the same loop dimension and angle of rotation, the strain energy of a wedge disclination loop is generally larger than that of a twist disclination loop. This is mainly due to the fact that, for these materials, the Young's moduli along the C axes are higher than those in the basal planes. (auth)

18895 PHASE TRANSITION OF In_3Sn AND ITS INFLUENCE ON THE SUPERCONDUCTING TRANSITION TEMPERATURE. Kubiak, R.; Zacharko, W.; Lukaszewicz, K. (Inst. for Low Temperature and Structure Research, Wroclaw, Poland). Phys. Status Solidi (b); 61: No. 1, K33-K39(1 Jan 1974).

In_3Sn single crystals were grown and subjected to x-ray powder diffraction after rapid cooling. In_3Sn cooled to 77°K over 20 to 30 h became superconducting at 5.10°K, while cooling in 1 h results in a transition temperature of 5.95°K. Thus, the "quench effect" appears to be caused by the phase transition. (DLC)

18896 ANISOTROPY OF THE ELECTRON MOMENTUM DISTRIBUTION IN VANADIUM. Paakkari, T.; Suortti, P.; Halonen, V.; Manninen, S. (Univ. of Helsinki). Phys. Fenn.; 8: No. 1, 93-98(May 1973).

The Compton profile of single-crystal vanadium was measured along the crystal directions [hOO] and [hhh] using 59.54-keV γ rays. The measured anisotropy, which corresponds to a charge transfer to the [hhh] direction, was found to be less than that predicted by previous diffraction experiments or by band-theoretical calculations. (auth)

18897 THEORETICAL STUDY OF THE ELASTIC PROPERTIES OF DYSPROSIUM ANTIMONIDE. Levy, P. M. (New York Univ., NY). J. Phys., C (London); 6: No. 24, 3545-3556(11 Dec 1973).

An expression is developed for the softening of an elastic constant of dysprosium antimonide. This softening is due to a Jahn–Teller coupling between magnetic ions whose ground manifolds are split into several levels by a crystalline field. This expression is evaluated in the molecular-field approximation and further approximated by considering only quadrupolar interactions. A good fit to the thermal variation of the elastic constant of dysprosium antimonide $C_\theta = \frac{1}{2}(C_{11} - C_{12})$ is obtained by suitably choosing the background elastic constant, the Jahn–Teller strain coupling g_θ and the biquadratic coupling I_θ. Several physical mechanisms are discussed that give rise to the fitted values of the parameters and to the structural and magnetic phase transition at 9.5°K. It is concluded that the phase transition is driven by approximately equal amounts of strain coupling g_θ and exchange interactions. (auth)

18898 CONCENTRATION AND MEAN FREE PATH OF THE CONDUCTION ELECTRONS IN SCANDIUM, YTTRIUM, AND LANTHANIDES. Reale, C. (Metal Lux, Milan). Appl. Phys.; 2: No. 4, 183-185(1973).

Measurements were carried out of the thickness dependence of the room-temperature electrical resistivity of vacuum-deposited polycrystalline films of scandium, yttrium and rare earth metals. Inserting these results into the size-effect relation giving the conductivity of thin deposits, and considering all the factors which can affect the mechanism of electron scattering at the surfaces, both the density and the bulk mean free path of the charge carriers were determined. (auth)

18899 MAGNETIC PROPERTIES OF Nd–GROUP V COMPOUNDS. Bak, P.; Lindgaard, P. A. (Danish Atomic Energy Commission, Risoe). J. Phys., C (London); 6: No. 24, 3774-3784(11 Dec 1973).

The Nd monopnictides NdP, NdAs, and NdSb are simple cubic type-I antiferromagnets in which the crystal-field splitting is larger than the exchange energy. The magnetic properties are calculated by means of a mean-field theory including crystal-field and magnetoelastic effects. The calculations are based on energy levels determined by inelastic neutron diffraction. Exchange constants are derived by comparing the theoretical paramagnetic susceptibility with experiments over a large temperature range. The temperature dependence of the sublattice magnetization deviates significantly from the usual molecular field curve (for $J = \frac{1}{2}$) which neglects crystal-field effects. Theoretical high-field magnetization curves are presented. The observed tetragonal distortion below the Néel temperature T_N is explained by the theory. The effect of a biquadratic exchange interaction is investigated. (auth)

18900 PRESSURE DEPENDENCE OF CURIE TEMPERATURE OF RARE EARTH–COBALT COMPOUNDS. Brouha, M.; Buschow, K. H. J. (Philips Gloeilampenfabrieken NV, Eindhoven, Netherlands). J. Phys., F (London); 3: No. 12, 2218-2226(Dec 1973).

The pressure dependence of the Curie temperature (T_c) was determined up to 40 kbar for the compounds R_2Co_{17}(R = Nd, Gd, Er, Y, and Th), RCo_5(R = Gd, Y, and Th), R_2Co_7(R = Gd and Y), RCo_3(Gd, Y, and Pr), and RCo_2(R = Gd and Tb). Single-phase compounds with off-stoichiometric composition were also included. Data are discussed in terms of the collective electron model. With few exceptions, the pressure derivative of T_c of the various compounds can be represented by a general relation of the form $dT_c/dP = 5/3kT_c - 5/6kB/T_c$ with $B = 3.5 \times 10^6K^2$ and T_c ranging from 400 to 1200°K. For the compounds Y_2Co_{17}, YCo_5, YCo_3, YCo_2, $GdCo_5$, $ThCo_5$, and Th_2Co_{17}, the compressibility k was determined. (auth)

18901 NUCLEAR SPIN CONFIGURATIONS IN (RARE EARTH) Fe_2 INTERMETALLICS. Bowden, G. J. (National Standards Lab., Sydney). J. Phys., F (London); 3: No. 12, 2206-2217(Dec 1973).

^{57}Fe nuclear spin configurations in the (rare earth)Fe_2 intermetallics were deduced from Moessbauer experiments on polycrystalline samples. It is shown that the ^{57}Fe nuclei do not, in general, point exactly along the direction of magnetization M. For example, the nuclear spins in $DyFe_2$ and $HoFe_2$ at room temperature are tipped away from the [100] magnetic axis by about 4°. The origin of this tipping is traced to the local dipolar fields in these compounds. The situation in intermetallics with a [111] direction of magnetization is more complex because of the presence of two nonequivalent iron sites. The case of $TbFe_2$ is dealt with in some detail and it is shown that the nuclei in "triangular nets" are collinear with M whereas those in "kagome nets" make a small angle with the [111] direction of magnetization. Some comments are also made on the possibility of magnetically induced electric field gradients in these compounds. (auth)

18902 SKEW SCATTERING IN ALLOYS WITH CERIUM IMPURITIES. Fert, A. (Paris Univ., Orsay, France). J. Phys., F (London); 3: No. 12, 2126-2142(Dec 1973).

Skew scattering by magnetic impurities in dilute magnetic alloys induces an extraordinary Hall effect that has now been observed in many systems. A calculation is given of the extraordinary Hall effect induced by cerium impurities for which the conduction electron–impurity interaction is mainly due to resonant scattering. Results are compared with experimental data on La–Ce alloys. A calculation is given also of the anisotropy of the magnetoresistance of such alloys and compared with preliminary experimental results. (auth)

18903 HIGH-FREQUENCY DE HAAS–VAN ALPHEN OSCILLATIONS AND THE FERMI SURFACE IN INDIUM. Weeren, J. H. P. V.; Anderson, J. R. (Univ. of Maryland, College Park). J. Phys., F (London); 3: No. 12, 2109-2119(Dec 1973).

De Haas–van Alphen oscillations from the second-zone and the third-zone Fermi surface in indium were studied. Emphasis is placed on the high-frequency oscillations attributed to the second

zone, which show a strong mixing with the medium-frequency oscillations from the third zone. Results combined with the low-frequency oscillations from the third zone surface measured by Hughes and Shepherd (J. Phys., C; 2: 661-72 (1969)) were used to obtain the parameters of an empirical pseudopotential calculation. The parameters in eV are: $V_{111} = -0.601$, $V_{002} = -0.435$, $V_{200} = 0.167$, and $E_F = 8.702$. (auth)

18904 THEORY OF HIGHLY ANISOTROPIC FERROMAGNETS. II. Renormalization of Magnon Energies in the Heavy Rare Earths. Brooks, M. S. (Portsmouth Polytechnic, Eng.); Egami, T. J. Phys., C (London); 6: No. 24, 3719-3736(11 Dec 1973).

Magnon energies, renormalized in a Hartree–Fock approximation, were derived. The model includes isotropic and anisotropic exchange interactions, a crystal field of hcp symmetry, magnetoelastic interactions, and dipolar interactions. The novel feature of the theory is a modification of magnon renormalization by the ellipticity of spin precession that is a characteristic of highly anisotropic ferromagnets. (auth)

18905 FRACTURE OF ZIRCALOY CLADDING UNDER SIMULATED POWER RAMP CONDITIONS. Garlick, A. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). J. Nucl. Mater.; 49: No. 2, 209-224(Dec 1973).

Behavior of Zircaloy cladding under stresses imposed by fuel dimensional changes is discussed, and results are presented that suggest that the correct choice of cladding properties, in particular cold-work level and texture, is important if the probability of low-ductility failures in fuel pins is to be reduced. Evidence is presented, based on laboratory tests and post-irradiation examination of cladding, which leads to the conclusion that failure of Zircaloy can take place by stress-corrosion cracking in the presence of fission-product iodine, and it is further demonstrated that the process is strongly stress-dependent. Consideration is given to the influence of irradiation exposure, strain rate, and adverse stress systems, for instance at inter-pellet ridges or fuel cracks, on the cracking susceptibility of Zircaloy cladding. The significance of the results is discussed in relation to a proposed stress-corrosion cracking mechanism. (11 figures, 27 references) (auth)

18906 FATIGUE-CRACK PROPAGATION IN UNIRRADIATED AND IRRADIATED ASTM A533-B STEEL AT LOW CYCLIC FREQUENCY. James, L. A.; Williams, J. A. (Westinghouse Hanford Co., Richland, WA). AT(45-1)-2170. J. Nucl. Mater.; 49: No. 2, 241-243(Dec 1973).

Unirradiated and irradiated ($5.3 - 5.7 \times 10^{19}$n/cm^2, E > 1.0 MeV) A533-B class 1 steel was fatigue cycled in air at 1 cpm and 75 and 550°F. Results, compared with data for 600 cpm, indicate that there is no effect of cyclic frequency in unirradiated material, although in the irradiated material the crack growth rate is slightly higher at 1 cpm than at 600 cpm. It is concluded that neither frequency nor temperature has a significant effect in air, in contrast to that in hot water. (DLC)

18907 TEORIYA ELEKTRONNOI EMISSII IZ METALLOV. (Theory of Electron Emission From Metals). Brodskii, A. M.; Gurevich, Yu. Ya. Sovremennye Problemy Fiziki. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Mathematicheskoi Literatury (1973). 256p.

The contemporary status of theoretical investigations in the area of electron emission from metals in vacuum, dielectrics, and solutions is reported. Formal mathematical apparatus, based on methods of nonrelativisitc quantum mechanical scattering theory, is developed. The theory of the concrete form of electron emission from metals is examined: external photoemission from vacuum–metal interfaces, dielectrics, thermo- and auto-emission, and photoemission at metal–electrolyte interfaces. New quantitative results are examined. Questions associated with the effect of surface layers on emission are considered. Emission in fields of electromagnetic waves of high intensity (for example, in laser fields) is examined. (tr-auth)

18908 SPLAVY S VYSOKIMI DEMPFIRUYUSHCHIMI SVOISTVAMI. (Alloys with High Damping Properties). Favstov, Yu. K.; Shul'ga, Yu. N. Moscow; Metallurgiya (1973). 256p.

Contemporary concepts on the mechanism of high damping in metallic materials are reported. The principles of processing of alloys of high damping are shown. Methods and apparatus for the measurement of the damping capacity of metals under increased amplitudes are described. The most promising alloys having significant damping capacities are examined. These include Mn–Cu and Mg–Zr alloys. Their basic physical, mechanical, and technological properties are reported. Examples are given of their use. (149 figures, 218 references) (tr-auth)

18909 STANDARD SPECIFICATION FOR Cr–Ni–Fe–Mo–Cu–Nb STABILIZED ALLOY BILLETS AND BARS FOR REFORGING. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-472-70).

Billets and bars to be used only for reforging are covered. Composition, ladle analysis, check analysis, tests inspection, and finally, certification are specified. (JRD)

18910 STANDARD SPECIFICATION FOR HOT-ROLLED AND COLD-FINISHED Zr AND Zr ALLOY BARS, ROD, AND WIRE FOR NUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-B-351-67).

Bars, rods, and wire, other than those required for reforging, including rounds, squares, and shapes are covered. Sections and sizes are specified, and the three grades include reactor-grade zirconium R-1 and zirconium–tin alloys RA-1 and RA-2. Requirements for chemical composition, dimensions, chemical composition, mechanical properties, and fabrication are included. (JRD)

18911 STANDARD SPECIFICATION FOR Zr AND Zr ALLOY SHEET, STRIP, AND PLATE FOR NUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-B-352-67).

This specification covers hot- and cold-rolled Zr and Zr–Sn alloy sheet, strip, and plate. Grades designated RA-1, R-1, and RA-2 suitable for nuclear application are described. The following forms and sizes are included: (1) sheet 24 in. or more wide, under 0.187 in. thick; (2) strip less than 24 in. wide, under 0.187 in. thick; and (3) plate over 10 in. wide, 0.187 in. and over thick. Requirements for chemical composition, chemical analysis, mechanical properties, testing, and inspection are included. (JRD)

18912 STANDARD SPECIFICATION FOR WROUGHT Zr AND Zr ALLOY SEAMLESS AND WELDED TUBES FOR NUCLEAR SERVICE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-353-71).

Seamless and welded wrought material is covered, including three grades: reactor-grade zirconium R-1, and zirconium–tin alloys RA-1 and RA-2, suitable for nuclear applications. Requirements are included for fabrication, chemical composition, mechanical properties, inspection, corrosion resistance, inspection, and testing. (JRD)

18913 STANDARD SPECIFICATION FOR Zr AND Zr ALLOY FORGINGS AND EXTRUSIONS FOR NUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-356-67).

The forgings shall include all shapes that have been formed with a hammer or a press while extrusions shall include all shapes formed by forcing material through a die, excluding tubing which is covered by ASTM Specification B 353 which covers seamless and welded tubing for nuclear applications. Three grades, designated as reactor-grade zirconium R-1 and zirconium–tin alloys RA-1 and RA-2, are described. Requirements for chemical composition, mechanical properties, testing, and inspection are included. (JRD)

18914 STANDARD SPECIFICATION FOR Ta INGOTS AND FLAT MILL PRODUCTS. 1973 ANNUAL BOOK OF ASTM STANDARDS. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-364-70).

This specification covers unalloyed powder-metallurgy, arc-cast, and electron-beam-cast Ta in the form of ingots, bars, plates, sheets, strips, and foils. Requirements for chemical composition, mechanical properties, fabrication, sampling, and dimensional tolerances are included. (JRD)

18915 STANDARD SPECIFICATION FOR Ta ROD AND WIRE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-B-365-70).

This specification covers powder-metallurgy, arc-cast, and electron-beam-cast unalloyed Ta rod and wire. Requirements for fabrication, chemical composition, dimensional tolerances, sampling, and tensile properties are included. (JRD)

18916 STANDARD SPECIFICATION FOR PRIMARY Nb METAL. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-383-64).

This specification covers primary Nb metal, including virgin Nb metal for consolidation or melting. It also covers Nb metal in the form of powder, roundels, beads, and sponge. Requirements for production, chemical composition, sampling, and mechanical properties are included. (JRD)

18917 STANDARD SPECIFICATION FOR Mo AND Mo ALLOY FORGINGS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-384-69).

Semi-finished shapes of unalloyed Mo, Mo–0.5%Ti, and TZM alloys are covered. Requirements for production, chemical composition, sampling, mechanical properties, and inspection are included. (JRD)

18918 STANDARD SPECIFICATION FOR Mo AND Mo ALLOY BILLETS FOR REFORGING. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-385-69).

This specification includes reforged unalloyed Mo, Mo–0.5%Ti, and TZM alloys. Requirements are included for production, chemical composition, mechanical properties, physical properties, inspection, and sampling. (JRD)

18919 STANDARD SPECIFICATION FOR Mo AND Mo ALLOY STRIP, SHEET, FOIL, AND PLATE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-386-69).

Arc-cast and powder-metallurgy unalloyed Mo and Mo–0.5%Ti alloys are covered. Requirements are included for production, chemical composition, mechanical properties, and dimensional tolerances. (JRD)

18920 STANDARD SPECIFICATION FOR Mo AND Mo ALLOY BAR, ROD, AND WIRE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-387-69).

This specification is for unalloyed arc-cast and powder metallurgy Mo, M–0.5%Ti, and TZM alloys. Requirements are included for production, chemical composition, mechanical properties, sampling, and dimensional tolerances. (JRD)

18921 STANDARD SPECIFICATION FOR Zr SPONGE AND OTHER FORMS OF VIRGIN METAL FOR NUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-349-67).

This specification covers metal commonly designated as sponge, but it may also take other forms such as chunklets. One grade is described that is designated Reactor-Grade R-1, the most important characteristic being its low nuclear cross section as achieved by removal of hafnium and careful quality control in manufacturing to prevent contamination with other high-cross-section materials. Requirements for chemical composition, chemical analysis, mechanical properties, and sampling are included. (JRD)

18922 STANDARD SPECIFICATION FOR Zr AND Zr ALLOY INGOTS FOR NUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-350-67)

This specification vacuum arc-melted ingots of reactor-grade zirconium R-1, and zirconium–tin alloys RA-1 and RA-2, are suitable for nuclear application. Requirements for conditioning, chemical composition, chemical analysis, mechanical properties, production, and inspection are included. (JRD)

18923 STANDARD SPECIFICATION FOR Ni–Mo ALLOY ROD. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-335-71).

Corrosion-resistant Ni–Mo rod in two conditions is covered: (1) hot-finished, annealed, and descaled, $^5/_{16}$ to $^3/_4$ in. excl., in diameter, and (2) hot-finished, annealed, and ground or turned, $^3/_4$ to $3^1/_2$ in. incl., in diameter. The term rod as used includes material of round solid section furnished in straight lengths. Requirements are included for chemical composition, chemical properties, physical properties, inspection, and testing. (JRD)

18924 STANDARD SPECIFICATION FOR Ni–Mo–Cr ALLOY ROD. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-336-71).

Corrosion- and heat-resistant material in two conditions is covered: (1) hot-finished, annealed, and descaled, $^5/_{16}$ to $^3/_4$ in. excl., in diameter, and (2) hot-finished, annealed, and ground or turned, $^3/_4$ to $3^1/_2$ in. incl., in diameter. The term rod as used includes material of round solid section furnished in straight lengths. Requirements for chemical composition, mechanical properties, physical properties, and dimension tolerances are included. (JRD)

18925 STANDARD SPECIFICATION FOR Ni–Mo ALLOY PLATE AND SHEET. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-333-71).

This specification covers material in the hot-rolled, annealed, and descaled condition, unless otherwise agreed upon between manufacturer and purchaser. The plate is specified as $^3/_{16}$ in. and over and the sheet as 0.187 in. and over. Requirements for alloy composition are included along with specifications bar grain size, physical properties, and mechanical properties. (JRD)

18926 STANDARD SPECIFICATION FOR ELECTRIC-FUSION-WELDED Cr–Ni–Fe–Mo–Cu–Nb Stabilized Alloy Pipe. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-474-68).

Alloys for high-temperature service in corrosive media are covered. Requirements are included for production, chemical composition, mechanical properties, testing, and inspection. (JRD)

18927 STANDARD SPECIFICATION FOR Cr–Ni–Fe–Mo–Cu–Nb ALLOY WEAVING WIRE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-475-70).

Material shall be made by electric-arc, electric-induction, or other suitable process. The last treatment shall be a solution-annealing heat treatment. Wire shall be annealed or cold drawn as a final operation to produce the specified mechanical properties. (JRD)

18928 STANDARD SPECIFICATION FOR Cr–Ni–Fe–Mo–Cu–Nb STABILIZED ALLOY BAR AND WIRE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 10p. (ASTM-B-473-70).

The specification covers alloy bar and wire other than required for reforging. Dimensions for rounds, squares, octagons, and hexagons are included. (JRD)

18929 STANDARD SPECIFICATION FOR Zr FORGINGS AND EXTRUSIONS FOR NONNUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-493-72).

Forgings and extrusions covered shall be formed with conventional equipment normally found in ferrous and nonferrous metal plants. The ingot metal shall be melted in furnaces of a type suitable for reactive metals. Specifications are also included for chemical composition, mechanical properties, testing, and surface properties. (JRD)

18930 STANDARD SPECIFICATION FOR PRIMARY Zr FOR NONNUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-494-72).

Only virgin Zr metal, in identified, uniform, well-mixed blends is covered, but the specification is not limited to metal prepared by reduction of $ZrCl_4$ or to material of any specific physical form. Requirements are also included for chemical composition, mechanical properties, and inspection. (JRD)

18931 STANDARD SPECIFICATION FOR Zr INGOTS FOR NONNUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-495-72).

Materials covered (up to 4.5% Hf allowed) shall be produced by multiple vacuum or inert-atmosphere melting in furnaces of a type conventionally used for reactive metals. Requirements are also included for chemical composition, mechanical properties, testing, and inspection. (JRD)

18932 STANDARD SPECIFICATION FOR SUPPLEMENTARY REQUIREMENTS FOR Ni ALLOY PLATE FOR NUCLEAR APPLICATIONS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-B-509-70).

This specification is for Ni–Cu alloys and Ni–Cr–Fe alloys and is intended to be used with a basic production specification; it applies to plate $^3/_4$ in. (19.0 mm) and over in thickness. Requirements are included for ultrasonic examination, weld repair, and certification. (JRD)

18933 STANDARD SPECIFICATION FOR SUPPLEMENTARY REQUIREMENTS FOR Ni ALLOY ROD AND BAR FOR NUCLEAR APPLICATIONS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-B-510-70).

This specification is intended to be used in conjunction with a basic production specification for Ni–Cu alloys and Ni–Cr–Fe alloys. Requirements are included for ultrasonic examination, liquid penetrant examination, weld repair, and certification. (JRD)

18934 STANDARD SPECIFICATION FOR Ni–Cr–Fe–Nb–Mo–W ALLOY ROD AND BAR. 1973 Annual Book of ASTM

Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-518-70).

The chemical requirements specify a Ni-base alloy with 14.0 to 16.0% Cr, 2.75 to 3.25% Nb + Ta, 2.75 to 3.25% Mo, 2.75 to 3.25% W, and 5.0 to 9.0% Fe. Also specified is Al 0.3 to 0.6%, Ti 0.4 to 0.7%, Mn 0.75% max., Si 0.40% max., C 0.08% max., Mg 0.01 to 0.05%, B 0.003 to 0.008%, Zr 0.01 to 0.05%, P 0.01% max., and S 0.01% max. Hot-worked rounds, squares, and rectangles, and cold-drawn rounds are covered. (LMT)

18935 STANDARD SPECIFICATION FOR Ni–Cr–Fe–Nb–Mo–W ALLOY PLATE, SHEET, AND STRIP. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 16p. (ASTM-B-519-70).

The chemical requirements specify a Ni-base alloy with 14.0 to 16.0% Cr, 2.75 to 3.25% Nb + Ta, 2.75 to 3.25% Mo, 2.75 to 3.25% W, and 5 to 9% Fe. Also specified is Al 0.3 to 0.6%, Ti 0.4 to 0.7%, Mn 0.75% max., Si 0.40% max., C 0.08% max., Mg 0.01 to 0.05%, B 0.003 to 0.008%, Zr 0.01 to 0.05%, P 0.01% max., and S 0.01% max. The product forms may be furnished in one of the following conditions: (1) annealed, (2) solution treated (cold-worked material only, or (3) deep drawing and spinning quality (cold-worked material only). (LMT)

18936 STANDARD SPECIFICATION FOR Ta AND Ta ALLOY TUBING. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-521-72).

This specification is for unalloyed Ta and Ta–10% W tubing. Requirements are included for chemical composition, mechanical properties, testing, dimensional tolerances, and inspection. (JRD)

18937 STANDARD SPECIFICATION FOR SEAMLESS AND WELDED Zr TUBES FOR NONNUCLEAR APPLICATION. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-523-72).

Material shall be made from ingots produced by multiple vacuum melting in furnaces of a type conventionally used for reactive metals and which conform to Specification B495. A lot shall consist of all material produced from the same ingot and of the same size, condition, and finish. (LMT)

18938 STANDARD SPECIFICATION FOR HOT WORKED AND COLD-FINISHED Zr BARS AND WIRE FOR NONNUCLEAR APPLICATIONS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-B-550-72).

Unalloyed material covered includes rounds, squares, and shapes and a Hf content of 4.5% max. is specified. Other chemical requirements, mechanical properties, dimensional tolerances, permissible variations and product sections and sizes are included in tables. (LMT)

18939 STANDARD SPECIFICATION FOR Zr FLAT-ROLLED PRODUCTS FOR NONNUCLEAR APPLICATIONS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-B-551-72-a).

This specification covers unalloyed material (up to 4.5% Hf max.) and products covered include flat material under 0.187 in. (4.75 mm) thick in all widths and material over 10 in. (254 mm) width and 0.187 in. and over in thickness. (LMT)

18940 STANDARD SPECIFICATION FOR Ni–Cr–Mo–Fe ALLOY ROD. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-572-72).

Material covered shall be furnished in the following conditions: (1) rods $^{5}/_{16}$ to $^{3}/_{4}$ in. excl., in diameter (hot finished, annealed, and pickled or mechanically descaled); and (2) rods $^{3}/_{4}$ to $3^{1}/_{2}$ in. incl., in diameter (hot finished, annealed, and ground or turned). The term rod as used includes material of round solid section furnished in straight lengths. The Ni-base alloy requirements are 20.5 to 23.0% Cr, 17 to 20% Fe, and 8 to 10% Mo, with other constituents under 1%. (LMT)

18941 STANDARD SPECIFICATION FOR Ni–Mo–Cr–Fe ALLOY ROD. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-573-72).

Conditions for the products furnished are the same as in Specification B 572. The Ni-base alloy requirements are 6.0 to 8% Cr, 5% max. Fe, and 15 to 18% Mo, with other minor constituents under 1%. (LMT)

18942 STANDARD SPECIFICATION FOR LOW-CARBON Ni–Mo–Cr ALLOY ROD. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-574-72).

Products covered under this specification shall be furnished in the same conditions as Specification B 572. Chemical requirements for the Ni-base alloy specify 14.5 to 16.5% Cr, 4.0 to 7% Fe, 2.5% max. Co, and 3.0 to 4.5% W, with other minor constituents under 1%. (LMT)

18943 STANDARD SPECIFICATION FOR LOW-CARBON Ni–Mo–Cr ALLOY PLATE, SHEET, AND STRIP. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-575-72).

The products covered shall be supplied in the following conditions: (1) sheet and strip—hot- or cold-rolled, solution-heat-treated, and descaled unless heated in an atmosphere yielding a bright finish; and (2) plate—hot-rolled, solution-heat-treated, and descaled. Plate material shall be $^{3}/_{16}$ in. and over and sheet and strip under $^{3}/_{16}$ in. in thickness. The Ni-base alloy chemical requirements are 14.5 to 16.5% Cr, 3.0 to 4.5% W, 4.0 to 7.0% Fe, 15.0 to 17.0% Mo, 2.5% max. Co, with other minor constituents under 1%. Mechanical properties, grain size, and permissible variations are specified in tables. (LMT)

18944 STANDARD SPECIFICATION FOR NUCLEAR-GRADE PLUTONIUM METAL. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-C-701-72).

This specification applies to Pu prepared by in-pile irradiation of natural or slightly enriched U; it does not apply to metal high in ^{238}Pu for use as an isotopic heat source. Requirements are included for isotopic content, sampling, isotopic analysis, packaging, handling, and shipping. (JRD)

18945 STANDARD SPECIFICATION FOR Nb AND Nb ALLOY INGOTS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-391-64).

Unalloyed reactor- and commercial-grade Nb and reactor-grade Nb–1 Zr alloys are covered. The ingot metal for all three types may be arc-melted, electron-beam melted, or consolidated by powder-metallurgical techniques, or a combination of these; or, other techniques suitable for refractory metals can be utilized. (JRD)

18946 STANDARD SPECIFICATION FOR Nb AND Nb ALLOY BAR, ROD, AND WIRE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-392-64).

This specification is for commercial- and reactor-grade unalloyed Nb and reactor-grade Nb–1 Zr alloys. Requirements are included for production, chemical composition, mechanical properties, quality control, sampling, testing, and dimensional tolerances. (JRD)

18947 STANDARD SPECIFICATION FOR Nb AND Nb ALLOY STRIP, SHEET, FOIL, AND PLATE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-393-64).

Wrought reactor-grade and commercial-grade unalloyed Nb and reactor grade Nb–1 Zr alloys are covered. Requirements are included for production, chemical composition, mechanical properties, quality control, dimensional tolerances, sampling, and inspection. (JRD)

18948 STANDARD SPECIFICATION FOR Nb AND Nb ALLOY SEAMLESS AND WELDED TUBES. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-394-70).

This specification covers wrought reactor-grade and commercial-grade unalloyed Nb and reactor-grade Nb–1 Zr alloys. Requirements are included for production, mechanical properties, quality control, chemical composition, sampling, inspection, and testing. (JRD)

18949 STANDARD SPECIFICATION FOR UNALLOYED SINTERED W BILLETS, BARS, RODS, AND PREFORMS FOR FORGING. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-410-68).

Preformed shapes produced by powder-metallurgical techniques and primarily intended for further processing by forging to semi-finished products are covered. Requirements are included for production, mechanical properties, physical properties, chemical composition, inspection, sampling, inspection, and dimensional tolerances. (JRD)

18950 STANDARD SPECIFICATION FOR PRIMARY Hf METAL SPONGE AND OTHER FORMS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-414-67).

This specification covers virgin Hf metal commonly designated

as sponge but it may also take other forms such as chunklets; it does not cover crystal bar. Requirements are included for production, chemical composition, hardness, and sampling. (JRD)

18951 STANDARD METHOD OF TEST FOR ELECTRICAL RESISTIVITY OF CEMENTED TUNGSTEN CARBIDES. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-421-67).

This method covers determination of the electric resistivity of cemented WC in various specimen configurations. Requirements are included for test apparatus, test procedure, and specimen preparation. (JRD)

18952 STANDARD SPECIFICATION FOR Ni-Fe-Cr-Mo-Cu ALLOY SEAMLESS PIPE AND TUBE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 9p. (ASTM-B-423-72).

This specification is for cold-drawn and hot-finished seamless pipe and tube intended for general corrosive service. Requirements are included for dimensional tolerances, chemical composition, inspection, sampling, and testing. (JRD)

18953 STANDARD SPECIFICATION FOR Ni-Fe-Cr-Mo-Cu ALLOY PLATE, SHEET, AND STRIP. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 11p. (ASTM-B-424-72).

This is a general specification for rolled material, and provision is made herein for the general run of drawing, forming, stamping, bending, and joining operations and all other common methods of fabrication. If use of the material is for very specific applications, these should be detailed to the manufacturer. (JRD)

18954 STANDARD SPECIFICATION FOR Ni-Fe-Cr-Mo-Cu ALLOY ROD AND BAR. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-B-425-72).

Material in the form of hot-finished and cold-drawn rounds, squares, hexagons, and rectangles is covered. Chemical requirements, mechanical properties, testing, analysis, permissible variations, etc. are specified. (JRD)

18955 STANDARD METHOD OF TEST FOR PARTICLE DISTRIBUTION OF W METAL POWDER BY TURBIDIMETRY. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-430-67).

This method covers determination of particle size in as-supplied and laboratory-milled W powder. Requirements are included for apparatus, reagents, conditioning of the powder, preparation of apparatus, procedure, and calculations. (JRD)

18956 STANDARD SPECIFICATION FOR Ni-Mo-Cr-Fe ALLOY SHEET AND PLATE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-434-71).

This specification covers corrosion-resistant alloys in annealed and descaled condition. Requirements are included for production, chemical composition, mechanical properties, sampling, testing and inspection. (JRD)

18957 STANDARD SPECIFICATION FOR Ni-Cr-Mo-Fe ALLOY SHEET AND PLATE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-435-71).

Corrosion-resistant material in the annealed and descaled condition is covered. The material shall be produced by hot working, annealing, pickling, reannealing, and polishing, or by any combination of these processes to the condition, finish, and dimensions specified. (JRD)

18958 STANDARD SPECIFICATION FOR Ni-Cr-Mo-Fe-Nb ALLOY SHEET AND PLATE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-436-71).

This specification covers corrosion-resistant material in the annealed and descaled condition produced by hot working, annealing, pickling, cold working, reannealing, and polishing, or by any combination of these processes. Plate and sheet shall be produced to the condition, finish, and dimensions specified. (JRD)

18959 STANDARD SPECIFICATION FOR CADMIUM METAL. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-B-440-69).

This specification is for refined Cd metal recovered from ores and other materials. Requirements are included for chemical composition and sampling. (JRD)

18960 STANDARD SPECIFICATION FOR Ni-Cr-Mo-Nb ALLOY PLATE, SHEET, AND STRIP. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 11p. (ASTM-B-443-72).

Rolled alloy plate, sheet, and strip are covered. Specified are such things as: chemical requirements; mechanical properties; dimensions, weights, and permissible variations; edges; workmanship and finish; testing; and inspection. It is emphasized that this is a general specification, and if particular requirements are needed, the purchaser should submit samples or detailed information to the manufacturer. (JRD)

18961 STANDARD SPECIFICATION FOR Ni-Cr-Mo-Nb ALLOY SEAMLESS PIPE AND TUBE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-444-72).

Seamless pipe and tube intended for general corrosive service and heat-resisting applications are covered. Chemical requirements, mechanical properties, pipe schedules, and permissible variations are included in tables. (JRD)

18962 STANDARD SPECIFICATION FOR Ni-Cr-Fe-Nb-Mo-W ALLOY SEAMLESS PIPE AND TUBE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-445-72).

This specification covers alloy cold drawn and hot finished and intended for general-corrosive service and for heat-resisting applications. Tables listing chemical requirements, mechanical properties, and permissible variations, and pipe schedules are included. (JRD)

18963 STANDARD SPECIFICATION FOR Ni-Cr-Mo-Nb ALLOY ROD AND BAR. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-446-72).

Alloy hot-finished rounds, squares, and rectangles, and cold-drawn rounds are covered. Tables listing chemical requirements, mechanical properties, permissible variations, and normal machining allowances are included. (JRD)

18964 STANDARD SPECIFICATION FOR W-BASE, HIGH-DENSITY METAL. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-459-67).

This specification covers powder-metallurgy produced W-base alloys containing metals such as Fe, Cu, or Ni as binders. Both materials that are cold-pressed and sintered and that are hot-pressed are included. (JRD)

18965 STANDARD SPECIFICATION FOR FORGED OR ROLLED Cr-Ni-Fe-Mo-Cu-Nb STABILIZED ALLOY PIPE FLANGES, FORGED FITTINGS AND VALVES, AND PARTS FOR CORROSIVE HIGH-TEMPERATURE SERVICE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-B-462-70).

The term "forgings" used in this specification shall be understood to cover one or all of the products mentioned above, either forged or rolled. The material shall be made by the electric-furnace process. All material shall be furnished in the stabilized annealed condition. Heat treatment may be performed before machining. (JRD)

18966 STANDARD SPECIFICATION FOR Cr-Ni-Fe-Mo-Cu-Nb STABILIZED ALLOY PLATE, SHEET, AND STRIP. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 15p. (ASTM-B-463-70).

The terms plate, sheet, and strip are defined dimensionally. If possible, the intended end use of the item should be given on the purchase order, especially when ordered for a specific end use or uses, to enable the manufacturer to produce a more satisfactory product. (JRD)

18967 STANDARD SPECIFICATION FOR SEAMLESS AND WELDED Cr-Ni-Fe-Mo-Cu-Nb STABILIZED ALLOY PIPE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-464-72).

The specification covers alloys for high-temperature and general-corrosive service. The pipe shall be pickled free from scale, unless bright annealing is used. All pipe shall be furnished in the stabilized annealed condition. (JRD)

18968 STANDARD SPECIFICATION FOR SEAMLESS AND WELDED Cr-Ni-Fe-Mo-Cu-Nb STABILIZED ALLOY TUBES. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-B-468-72).

This specification covers average-wall seamless and welded-stabilized-alloy boiler, heat exchanger, and condenser tubes and tubing for general corrosion-resisting and low- or high-temperature service. Requirements are included for production, chemical composition, mechanical properties, testing, dimensional tolerances, and inspection. (JRD)

18969 STANDARD SPECIFICATION FOR Cr–Ni–Fe–Mo–Cu–Nb ALLOY SPRING WIRE. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 4p. (ASTM-B-471-71).

Stabilized alloy round wire intended especially for manufacture of springs is covered. When the purchaser specifies that the wire shall be suitable for automatic coiling, it shall have a thin and uniform surface film of a metallic or nonmetallic substance that will prevent the coiling tool from seizing or galling the wire. (JRD)

18970 STANDARD SPECIFICATION FOR Ni–Mo–Cr ALLOY PLATE AND SHEET. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-B-334-71).

This specification corrosion- and heat resistant hot-rolled plate ($^3/_{16}$ in. and over) and hot-rolled sheet (0.187 in. and under) in the annealed and descaled condition, unless otherwise agreed upon between manufacturer and purchaser. Requirements for chemical composition are included along with those for mechanical properties, grain size, physical properties, and inspection. (JRD)

18971 NUCLEAR MAGNETIC RESONANCE OF ^{113}Cd AND ^{199}Hg IN Cd–Mg AND Cd–Hg SOLID SOLUTIONS. Zhukov, V. V.; Weisman, I. D.; Bennett, L. H. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 77A: No. 6, 713-723(1973).

The current theoretical and experimental situation with respect to Knight shifts and bulk susceptibility of Cd in pure Cd and in Cd–Mg and Cd–Hg alloys is reviewed. New experimental isotropic and anisotropic Knight shift data on ^{113}Cd in Cd–Mg and Cd–Hg alloys and on ^{199}Hg in Cd–Hg alloys are presented. The behavior of the ^{199}Hg sites is found to be remarkably similar to that of the ^{113}Cd site in the Cd–Hg alloys. However the ratio of isotropic Knight shift of ^{199}Hg to ^{113}Cd is somewhat greater than the ratio of ^{199}Hg to ^{113}Cd atomic hyperfine fields, suggesting that there is more local electronic s character at the Fermi surface in the alloy than in the pure metals. This is consistent with the theoretical picture of Cd in which phonon scattering induced by increasing temperature or alloying smears and weakens the lattice potential which in turn leads to a more s-like Fermi surface. Further, the ^{113}Cd Knight shift is found to be a useful tool for monitoring the phase segregation that occurs in Cd–Mg due to internal oxidation and for determining the concentrations of solutes such as Hg and Mg in Cd–Hg and Cd–Mg alloys. (5 tables, 14 figures, 36 references) (auth)

18972 HYPERFINE INTERACTIONS AND RELAXATION EFFECTS IN LAVES-PHASE INTERMETALLIC COMPOUNDS OF NEPTUNIUM. Gal, J. (Nuclear Research Center-Negev, Beer Sheva, Israel); Hadari, Z.; Atzmony, U.; Bauminger, E. R.; Nowik, I.; Ofer, S. Phys. Rev., B; 8: No. 5, 1901-1911(1 Sep 1973).

Magnetic properties of cubic Laves-phase compounds of Np were studied using the Moessbauer effect of the 59.5-keV transition in ^{237}Np. The compounds studied were $NpAl_2$, $NpCo_2$, $NpNi_2$, $NpFe_2$, and $NpIr_2$. Hyperfine-interaction parameters and ordering temperatures were deduced from these measurements. If the values of $H(T)/H(0)$ are plotted as a function of T/T_C, the points (except those of $NpFe_2$) lie on the molecular-field-theory curve for $S = ^1/_2$. Quadrupole interactions were found to be very small. This behavior is consistent with the assumption that the ground crystalline state in these compounds is an isolated Kramers doublet. Relaxation phenomena were observed in the spectra. The spectra could be fitted by assuming relaxation effects within the Kramers doublet with a relaxation time of $\sim 4 \times 10^{-11}$ s. Isomer shifts were measured and found to change regularly with the size of the unit cell. (6 tables, 15 figures) (auth)

18973 ELASTICITY PHENOMENA DURING SPIN ROTATION IN $Ho_xTb_{1-x}Fe_2$ CUBIC LAVES COMPOUNDS. Rosen, M.; Klimker, H.; Atzmony, U.; Dariel, M. P. (Nuclear Research Centre-Negev, Beer Sheva, Israel). Phys. Rev., B; 8: No. 5, 2336-2340(1 Sep 1973).

The temperature dependence of the elastic moduli in $Ho_xTb_{1-x}Fe_2$ cubic Laves compounds was investigated by means of an ultrasonic technique in the temperature region where spin rotation occurs. The composition-dependence minima in the elastic moduli reveal the boundary between the different directions of easy magnetization in these compounds. Results of ultrasonic measurements as a function of temperature and magnetic field are in satisfactory agreement with the theoretical spin-orientation diagram based on the one-ion model. The variation of the temperature derivatives of the elastic moduli at the spin-rotation temperatures is indicative of a first-order phase transition. (auth)

18974 FATIGUE CRACK GROWTH CHARACTERISTICS OF SEVERAL AUSTENITIC STAINLESS STEELS AT HIGH TEMPERATURE. Shahinian, P.; Smith, H. H.; Watson, H. E. (Naval Research Lab., Washington, DC). pp 387-398 of Fatigue at Elevated Temperatures. Philadelphia; American Society for Testing Materials (1973).

The resistance to fatigue crack growth of annealed stainless steels, Types 304, 316, 321, and 348, was determined at 77,800, and 1100°F. Crack growth rates were related to the stress intensity factor range (ΔK). With increase in temperature the rate of crack growth for a given ΔK increased. At room temperature the four steels had the same resistance to crack growth. However, at high temperatures crack growth became sensitive to the differences in composition and properties among the steels. At 1100°F, Type 348 steel had the greatest resistance to crack growth and Type 316 the lowest resistance. As a result, fatigue life was 3.4 times longer for Type 348 steel over Type 316 steel at this temperature. The characteristics of high-temperature fatigue crack growth were examined. (auth)

18975 SOME PROBLEMS CONNECTED WITH BOILING OF ALKALI METALS. Zeigarnik, Yu. A.; Litvinov, V. D. (Inst. of High Temperatures, Moscow). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 2, 35-43(Feb 1973).

Translated from Teploenergetika; 20: No. 2, 27-32(1973).

An investigation was made of problems connected with incipient boiling superheat of liquid metals and cover boiling; heat transfer with developed boiling and in the region of deterioration in heat transfer; and the problem of stability of the boiling process and of the flow regimes of two-phase liquid metals. Emphasis has been placed on incipient boiling superheat due to the problem of ensuring safe operation of fast reactors cooled by liquid sodium. An examination of the experimental and theoretical data indicates complex interactions. Hydrodynamics and heat transfer that arise as a result of boiling with high superheats and technical measures to reduce the superheat are discussed. (24 references) (MCW)

18976 PLASTICHESKAYA DEFORMATSIYA BERILLIYA. (Plastic Deformation of Beryllium). Papirov, I. I.; Tikhinskii, G. F. Moscow; Atomizdat (1973). 304p.

The physical bases of the plastic deformation and fracture of Be are reported. Results of studies on the basic, prismatic, and pyramidal slips and twinning in monocrystals and the dependence of the mechanical characteristics of polycrystals on the grain size and impurity concentration are also reported. The dislocation mechanisms of the elementary forms of deformation and fracture were determined and are described. A comparative analysis was made of the plastic deformation of metals with hexagonal structure. (200 references) (tr-auth)

18977 MOESSBAUER INVESTIGATION OF BINDING PROPERTIES IN XFe_2 LAVES PHASE. Linchevskaya, M. I.; Nadzhafov, A. Yu. Izv. Akad. Nauk SSSR, Metal.; No. 6, 169-170(1972). (In Russian).

The analysis showed that the interatomic bonds in Laves phases are not purely metallic but have a covalent contribution. The ratio of the metallic to the covalent bonds depends on the type of lattice and the nature of the X element in the XFe_2 phase, where X is Nb, W, Mo, Ti, Dy, Ho, and Er. (tr-auth)

18978 ELECTRIC FIELD GRADIENT AT TANTALUM IN YTTRIUM. Butz, T. (Technische Univ., Munich). Phys. Lett.; 46A: No. 3, 231-233(17 Dec 1973).

A uniform, axially symmetric electric field gradient at ^{181}Ta in hcp Y of $|eq| = (5.9 \pm 0.3) \times 10^{17}$V/cm^2 at 300°K, increasing by 11% upon cooling to 4.2°K, was found using the time-differential perturbed-angular correlation technique. (auth)

18979 ANOMALOUS PHOTOCONDUCTIVITY. Korsunskii, M. I. New York; John Wiley and Sons, Inc. (1973). 174p. $23.00.

Translated from Russian by E. Harnik.

This book investigates the nature and properties of anomalous (negative) photoconductivity observed in specially treated (mercury-activated) amorphous selenium films. A phenomenological theory is given, some properties of long-life traps are described, and a new type of centers (s-centers or storage centers) is discussed. Preparation of anomalously photoconductive Se and possible applications are considered. (86 references) (DLC)

Radiation Effects

Refer also to abstracts 18787 and 20069.

18980 (AERE-TP-538) TERMINATION OF VOID GROWTH IN IRRADIATED MATERIALS. Brailsford, A. D.; Bullough, R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jun 1973. 17p. Dep. NTIS (U.S. Sales Only) $3.00.

Some of the factors that determine the high-temperature high-irradiation dose behavior of materials containing growing voids are examined and discussed. The relevant high-temperature parameters are gas generation rate, deformation dislocation density, applied stress, surface energy, and grain size. The dominant saturation process in the dependence of swelling against dose at the peak swelling temperature is considered to arise from the "induced" interactions between the irradiation-produced dislocations and the voids. (auth)

18981 (AERE-TP-542) SWELLING OF IRRADIATED MATERIALS. Brailsford, A. D.; Bullough, R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1973. 22p. Dep. NTIS (U.S. Sales Only) $3.25.

Steady-state void growth in irradiated materials is achieved by an excess flow of vacancies to voids to counterbalance the excess flow of interstitials to dislocations. The swelling is small at low temperatures because of the dominance of interstitial–vacancy recombination and also at high temperatures where thermal re-emission of vacancies from the voids is of importance. In the intermediate void swelling temperature region the magnitude of the effect, and its dependence upon dose rate, is sensitive to the scale and character (i.e., homogeneous or heterogeneous) of the nucleation of voids and interstitial dislocation loops, to the generation of helium by (n,α) reactions (which counteracts the void surface-tension effects), to the magnitude of the applied stress and the density of deformation dislocations present in the un-irradiated material, to the grain size, and to the dispersion of second-phase precipitates when present. These effects are incorporated within a rate theory of the swelling process, the results of which are summarized in a comparison with some observations from fast reactor irradiations and simulation experiments at high dose rates. (24 references, 6 figures) (auth)

18982 (COO-1198-1036) CONTRIBUTIONS FROM POINT DEFECTS TO THE ELASTIC CONSTANTS OF COPPER. Rehn, L. E. (Illinois Univ., Urbana (USA)). Feb 1974. Contract AT(11-1)-1198. 125p. Dep. NTIS $8.25.

Thesis.

The changes introduced in a complete set of independent copper elastic constants (C_{11}, C_{44} and C') by irradiation with thermal neutrons below 4°K were measured. Simultaneous measurements of attenuation and resistivity were also performed, and the change in attenuation due to the introduction of defects was determined. The high degree of sensitivity achieved by using a pulse-echo superposition technique permitted a study to be made of the annealing of these effects through most of stage I. It was found that the contributions at liquid-helium temperatures from different stage I defects to a particular elastic constant were not the same, and the magnitude of the effect from a given defect was found to vary among different constants. Significant temperature dependent effects were also observed in all the elastic constants. The results are discussed in terms of four different effects: a small bulk effect; a larger polarization effect, which involves the stress induced internal displacement of certain defects; a thermally activated relaxation process; and a change in the vibrational spectrum of the lattice from the introduction of defect resonance modes. The indication of a small bulk effect is in agreement with the range of reported theoretical estimates. The results obtained at 3.6°K for the recovery of the results during stage I_D are qualitatively in agreement with a calculation by Dederichs of the polarizability of the ⟨100⟩-split interstitial. The relaxation process previously reported by Nielson and Townsend was observed and attributed to the I_C defect. A model of this defect is proposed. No other relaxation of stage I defects was observed. The measurements indicate that both the I_D and I_E defects change the temperature dependence of the elastic constants by introducing resonance modes into the vibrational spectrum of the lattice. The frequency obtained from an analysis of stage I_D is believed to be $5 \times 10^{12} \pm 30\%$ Hz, and is in reasonable agreement with the value of approximately 6×10^{12} Hz obtained by Dederichs et al. with a computer simulation of a ⟨100⟩-split interstitial in a copper lattice. The contribution from this effect to the temperature dependence of other physical properties (resistivity, specific heat and thermal expansion) is discussed. The results obtained are helpful in understanding apparent discrepancies in previously reported measurements of irradiation-induced changes in the elastic constants. (auth)

18983 (GKSS-73-E-18) IRRADIATION TESTS ON A HEAT-RESISTING REACTOR PRESSURE VESSEL STEEL FOR A GAS-COOLED REACTOR. Schmitt, F. J. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht-Tesperhunde (F. R. Germany)). 1973. 25p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

Irradiation tests on notch impact strength, rupture, and notched-bar tensile properties have been carried out on a heat resisting steel (13 Cr Mo 44) which seems to be particularly suitable as a pressure container material for gas cooled high temperature reactors. From the investigations, it can be seen that stronger irradiation effects are noticeable at the chosen irradiation temperature of 480°C only at high irradiation doses, as in this temperature range, the healing effects compensate to a great extent for the damaging effects of the neutrons. (GE)

18984 (NAA-SR-12031) POST-OPERATION EVALUATION OF FUEL ELEMENTS FROM THE SNAP 10 FLIGHT SYSTEM 3 REACTOR. Golding, T. A. (Atomics International, Canoga Park, Calif. (USA)). 15 Sep 1967. Contract AT(04-3)-701. 40p. Dep. NTIS $4.00.

Declassified 28 Nov 1973.

The S10FS-3 Reactor was disassembled and examined. The core was removed from the core vessel and all 37 fuel elements were subjected to a nondestructive screening examination followed by a detailed examination of selected elements. The screening examination consisted of visual inspection, dimensional measurement, eddy current scanning for hydrogen distribution, and gamma scanning. The subsequent detailed examination of selected elements included fission gas measurement, determination of hydrogen permeation rate, inspection of disassembled fuel elements, dimensional measurement of fuel, fuel density determination, hydrogen analysis, and fuel and cladding metallography. No defects or unexpected results were observed, and the examination firmly supported the conclusion that all the fuel elements completed the reactor operation in good condition. (auth)

18985 (ORNL-tr-2795) MICROPROBE INVESTIGATIONS OF IRRADIATED URANIUM CARBIDE. Kleykamp, H. Translated by Klaus Becker from J. Nucl. Mater.; 47: 271-277(1973). 9p. Dep. NTIS $3.00.

A shielded Cameca microprobe, MS 46, was used to examine a UC sample canned in SAP and irradiated to a burnup of 0.7%. An annular zone at about 40% of the outer sample radius was seen to contain precipitates loaded with fission products; microprobe analysis showed the precipitates to be U_2 (Tc, Ru, Rh)C_2. Small amounts of palladium can be stabilized in this phase. Zirconium and molybdenum were verified in homogeneous distribution in the fuel. The Vickers hardness of the irradiated UC is 1000 to 1200 kg/mm². No signs of incompatibility with the canning material were detected. (auth)

18986 CONTRIBUTION OF BORON TO RADIATION EFFECTS FOR PRESSURE VESSEL STEEL WELDMENT. Kawasaki, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 515-516(Aug 1973).

The fission-track etching technique was used to determine the B microdistribution in an ASTM A533B steel weldment. B segregates on γ grain boundaries in the heat-affected zone; the B content is 12 ppM in the deposit and 1 ppM in the base metal. The effect of the B segregation on the radiation embrittlement was estimated. A possible reason for the wide scatter in the Charpy impact values of the heat-affected zone and bond interfaces is given. (DLC)

18987 RADIATION DAMAGE IN THIN NICKEL AND IRON FILMS AFTER HELIUM-ION IRRADIATION. Bykov, V. N.; Zdorovtseva, G. G.; Troyan, V. A.; Khabarov, V. S.; Khaimovich, V. S. (Moscow Engineering-Physics Inst., Obninsk). Fiz. Metal. Metalloved.; 36: No. 3, 647-652(1973). (In Russian).

Nickel and iron thin films irradiated with fast helium ions showed structural changes after a dose of 10^{17} ions/cm². Annealing of the Ni films at 200°C gradually reversed the changes, but with Fe, reversal occurred only with annealing at 650°C. Gas pores were formed in some of the irradiated films, and contact-type dislocations in others. The changes appear to be related to lattice defects. (tr-auth)

18988 ORIENTATION DEPENDENCE OF BLISTER SHAPE IN NIOBIUM MONOCRYSTALS IMPLANTED WITH CHANNELED HELIUM IONS. Kaminsky, M.; Das, S. K. (Argonne National Lab., IL). Appl. Phys. Lett.; 23: No. 6, 293-295(15 Sep 1973).

The shape, size, and orientation of blisters formed on the (111), (110), and (001) surface planes of monocrystalline niobium samples irradiated at 900°C with 0.5-MeV channeled $^4He^+$ ions were studied. Results indicate a strong dependence of the blister shape and the orientation of the blisters with respect to each other on the crystallographic orientation of the target. Both observations can be related

to the intersection of certain active slip planes with the surface plane of the monocrystal during blister formation. This interpretation elucidates the anomaly in the alignment of the blisters on Nb (111) planes. (auth)

18989 EXTENSION OF THE UNSATURABLE TRAP MODEL TO ONE-DIMENSIONAL INTERSTITIAL MIGRATION. Goesele, U.; Frank, W. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 61: No. 1, 163-172(1 Jan 1974).

For most fcc metals, the increase of the electrical resistivity due to stage-II temperature irradiation may be interpreted in terms of trapping of mobile interstitials at unsaturable traps. This model originally elaborated for interstitials migrating in three dimensions predicts that the inverse of the production rate of defects retained in an irradiation-exposed sample increases linearly with the defect concentration. Using three different methods (rate equation approach, diffusion theory, and a computer simulation technique) it will be shown that this relationship remains valid if the mobile interstitials are off-line crowdions and thus constrained to a long-range migration in one dimension. It is therefore not admissible to draw any conclusions about the nature of self-interstitials in fcc metals from radiation damage curves measured at stage-II temperatures, contrary to what has repeatedly been done in the literature. (auth)

18990 ISOCHRONAL RECOVERY OF FAST-NEUTRON-IRRADIATED METALS. Horak, J. A.; Blewitt, T. H. (Argonne National Lab., IL). J. Nucl. Mater.; 49: No. 2, 161-180(Dec 1973).

The isochronal recovery of Al, Ni, Cu, Ag, Au, Pt, Fe, Mo, and Co, irradiated at 4.5°K with fast neutrons was studied resistometrically. For the fcc elements Al, Ni, Cu, Ag, and Au, the magnitude of stage I recovery is inversely proportional to the atomic mass of these elements, which is in excellent agreement with recent calculations on the spatial distribution of lattice defects in fast neutron-irradiated metals. The total irradiation-induced resistivity and hardness of neutron spectra have more of an influence on the details of the recovery stages than does the initial residual resistivity and the initial resistivity ratio. Stage II recovery, at least in Cu, can be explained best by the rearrangement and/or annihilation of defects that are released from the stress fields of the vacancy clusters that exist in fast-neutron-irradiated metals. (13 figures, 7 tables, 21 references) (auth)

18991 EVOLUTION OF DISLOCATION DENSITY IN TYPE-316L AUSTENITIC STAINLESS STEELS IRRADIATED BY MEDIUM-ENERGY Ni^+ IONS. Azam, N.; Le Naour, L.; Delaplace, J. (CEN, Saclay, France). J. Nucl. Mater.; 49: No. 2, 197-208 (Dec 1973). (In French).

Changes in dislocation density were examined in stainless steels of Type 316L on irradiation by 500-keV Ni^+ ions. Over a wide temperature range (400 to 700°C) a high dislocation density was observed. This density was independent of the initial state of the material (hyperquenched or deformed) and of the dose, once this had attained the level of 10 dpa (equivalent to 2×10^{22} n/cm^2 approx.). The dislocation density increased with instantaneous flux and decreased as the irradiation temperature rose. The irradiation-induced change of the mechanical properties of Type 316 stainless steels can be explained, at least partially, in terms of the rapid disappearance of the initial dislocation network in deformed material and the saturation of the dislocation density created by irradiation in hyperquenched or deformed material. (8 figures) (auth)

18992 PHENOMENOLOGY OF HELICAL SPRING CREEP SPECIMENS WHICH ARE SWELLING. Lewthwaite, G. W. (Dounreay Experimental Reactor Establishment, Thurso, Scotland). J. Nucl. Mater.; 49: No. 2, 235-237(Dec 1973).

Equations were derived for the deflections of helical springs due to dimensional changes and changes in elastic constants. Comparison of these deflections with creep rates of the most creep-resistant stainless steel shows the latter to be larger by at least a factor of 5. It is concluded that no significant corrections are necessary to previous data and that helical springs are still feasible as creep specimens. (DLC)

18993 EFFICIENCY OF VOID FORMATION DURING ANNEALING OF IRRADIATED MOLYBDENUM. Evans, J. H. (Danish Atomic Energy Commission, Risoe). Phil. Mag.; 28: No. 6, 1405-1408(Dec 1973).

Results show that, when voids are formed by annealing molybdenum at 900°C after neutron irradiation at 60°C, vacancies are retained with an efficiency about fifty times greater than the maximum possible when the material is irradiated at high temperatures. This high efficiency is considered in the light of recent positron annihilation studies of annealing in irradiated molybdenum by Petersen, Thrane, and Cotterill (private communication)(1973), and is thought to be due to the storage of vacancies in loop form below the temperature of vacancy loop shrinkage, and their transfer to voids on annealing above this temperature. The possible relevance to reactor situations and the 0.3 T_m threshold are discussed. (auth)

18994 INFLUENCE OF GRAIN BOUNDARIES ON VOID GROWTH. Singh, B. N. (Danish Atomic Energy Commission, Risoe). Phil. Mag.; 28: No. 6, 1409-1413(Dec 1973).

Growth behavior of four individual voids was studied using 1-MeV electron irradiation in a high-voltage electron microscope. Direct evidence is presented to show that the growth rate of voids is reduced markedly as the distance between the growing voids and grain boundaries becomes smaller than the "defect depleted zone width". As soon as grain boundaries reach growing voids, the void growth is found to cease altogether. At a given damage rate a void isolated from grain boundaries and other voids is found to follow a growth law of the form $d_v \propto t_i^{\frac{1}{2}}$, where d_v is the void size and t_i is the irradiation time. (auth)

18995 IRRADIATION CREEP PRODUCED BY EFFECT OF STRESS ON NUCLEATION OF DISLOCATION LOOPS. Lewthwaite, G. W. (Dounreay Experimental Reactor Establishment, Eng.). Phil. Mag.; 28: No. 6, 1287-1302(Dec 1973).

A general expression for the creep strain produced by a distribution of dislocation loops is derived and applied to the nucleation (assumed subject to Boltzmann statistics) of prismatic loops in bcc and fcc metals and alloys subjected to neutron irradiation. The nucleation of the loops is considered to take place in several stages, viz., an initial growth of small platelets of atoms on (110) planes (bcc metals) or Frank loops on (111) planes (fcc metals), followed by unfaulting and then conservative rotation to the pure edge orientation. The equations for the creep strain for low applied stresses explicitly contain terms relating to the various stages involved in the nucleation of the loops and show, inter alia, that rotation to the pure edge orientation does not cancel the strain produced by prior unfaulting. (auth)

18996 STEREO-ELECTRON MICROSCOPY OF LOW-ENERGY ION-BOMBARDED GOLD. Thomas, G. J.; Venables, J. A. (Univ. of Sussex, Brighton, Eng.). Phil. Mag.; 28: No. 6, 1171-1201 (Dec 1973).

Pure gold foils (99.999 and 99.9999%) containing vacancy stacking-fault tetrahedra were irradiated inside an electron microscope with 300-eV Xe^+ ions. It was found that tetrahedra $\gtrsim$1000 Å from the irradiated surface were affected by the irradiation at temperatures as low as 25°K. The mode of shrinkage of the tetrahedra was examined and found to be different at 77°K and below, and above 200°K. This transition is associated with the onset of interstitial migration across a stacking fault. The total amount of vacancy loss and the depth dependence of vacancy loss, as determined by stereomicroscopy, were found to be essentially independent of temperature from 25 to 283°K but were clearly different for the two materials of different purities. In addition, interstitial clusters were observed, and the observed density was correlated with temperature and material purity. These results are consistent with a model in which interstitials are mobile throughout the temperature range investigated, while impurities act as deep traps for these defects. The results put extremely severe constraints on other models for interstitial production and migration in gold, which are examined in some detail. (auth)

18997 RADIATION-INDUCED DOPING EFFECTS IN α-TIN. Gardiner, R. B.; Myhra, S. (Univ. of Queensland, St. Lucia, Australia). J. Appl. Phys.; 44: No. 9, 4238-4239(Sep 1973).

An n → p transition was observed for α-tin filaments irradiated with 0.675-MeV electrons at 5°K. Resistance and thermoelectric emf measurements were used to establish that the electron dose needed to effect the n → p transition is roughly proportional to the impurity concentration for n-type material. No transition was observed for p-type material. The data are interpreted in terms of radiation-induced trapping levels. (auth)

18998 MAGNETIC ANISOTROPY INDUCED BY SELF-INTERSTITIALS IN LOW-TEMPERATURE ELECTRON-IRRADIATED IRON. Verdone, J.; Chambron, W.; Moser, P. (CEN, Grenoble, France). Phys. Status Solidi (b); 61: No. 1, K41-K44(1 Jan 1974).

Magnetic torque measurements under saturating magnetic field were made on polycrystalline Fe after 20°K irradiation by 3-MeV electrons. Effects of heat treatments on the anisotropy energy were studied. Results indicate that irradiation creates defects which are slowly mobile at 96 to 103°K. A plot of reorientation time constants by magnetic after-effect and internal friction gives a reorientation energy of 0.320 ± 0.015 eV. The magnetic after-effect is due to a three-dimensional migrating defect which reorients at each jump. (DLC)

18999 SPATIAL DISTRIBUTION OF RADIATION DEFECTS IN BISMUTH IRRADIATED WITH PROTONS. Gumanskii, G. A.;

Kumakhov, M. A.; Tashlykov, N. S. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR; 17: No. 9, 797-800(Sep 1973). (In Russian).

The profile of the defects created in Bi crystals by irradiation with 100-keV protons was theoretically calculated. For comparison the experimental profiles in pure and admixed Bi after irradiation with 100-keV protons was shown. Experimentally calculated profiles of the defects were obtained from investigations on the backscattering of channeled He ions. An explanation was proposed for the observed difference in the theoretical and experimental curves. (tr-auth)

Other Materials

Refer also to abstracts 18029, 18138, 18520, 18840, 19042, 20028, 20031, 20032, 20209, 20516, 20540, 20559, and 20577.

19000 (GERHTR-68) IRRADIATION-INDUCED CHANGE IN THE ORIENTATION ANISOTROPY IN PYROCARBON COATINGS OF FUEL-OXIDE PARTICLES. Koizlik, K.; Koss, P. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe; Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). 1 Jan 1973. 8p. Dep. NTIS $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

$(U,Th)O_2$ particles coated with pyrocarbon in the presence and absence of an intermediate SiC layer were heated or irradiated by fast neutrons. Two conditions were derived for the occurrence of increases in orientation anisotropy: (1) a large number of lattice imperfections must be present, produced either by annealing or the low irradiation temperature of 1000°C, and (2) far-reaching macroscopic stresses must be present in the coating, produced by gas pressure or swelling/shrinkage. (DLC)

19001 (SRARI-P-184) TESTING THE PERFORMANCE OF DKM-6 ENGINES UNDER IRRADIATION. Aseev, N. A.; Losev, N. P.; Samsonov, B. V.; Tsykanov, V. A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 36p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The results are presented on experimental testing of the performance of two DKM-6 engines in the flux of mixed radiation of various intensities. The engines were irradiated in one of SM-2 reactor channels during intermittent engine operation. The experimental methods to provide the required temperatures and measurements of the electrical characteristics are presented. It is shown that the integrated doses of 4.63×10^{17} fast neutrons/cm^2, 5.48×10^{18} thermal neutron/cm^2 and 5×10^{10} rad of fast neutrons, thermal neutrons, and γ radiation, respectively, are close to maximum permissible doses for engines of this design both in relation to the state of electrical insulation materials and to that of a special material for bearings with solid lubrication. (tr-auth)

19002 SUBMICROPOROSITY IN CARBON MATERIALS. Virgil'ev, Yu. S.; Zelentsova, E. V.; Kurolenkin, E. I. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 7, 1124-1125(Jul 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 7, 1264-1265(Jul 1973).

Alteration of the submicroporosity of carbon materials by heat treatment and by pyrocarbon impregnation was investigated along with the effects of graphite microstructure on the relative change in the volume of submicropores of carbon materials in relation to the crystallite volume when subjected to irradiation. It was found that in specimens heat treated at ~2400°C there is a decrease in pore volume and a decrease in the number of pores. Impregnation with graphite was found to result in filling both coarse and fine pores so that the specific surface area is not altered much until saturation is reached. Results of the distribution and size of pores in irradiated graphitic materials are discussed. (JRD)

19003 PARAMETERS OF Yb IMPLANTATION IN CdS, ZnS, AND ZnSe. Fewster, R. H.; Bryant, F. J. (Hull Univ., Eng.). Phil. Mag.; 28: No. 6, 1225-1239(Dec 1973).

The intensity of the characteristic Yb^{3+} cathodoluminescence emission spectrum was used to monitor the implantation of ytterbium in CdS, ZnS, and ZnSe. The effects on the implantation of varying ion fluence, ion flux, implant temperature, and anneal temperature were studied and found to be important. Optimum values of these parameters for ytterbium implantation were determined. It was shown that implantation at liquid helium temperatures rather than at higher temperatures could lead to greater structure in the emission spectrum of the implanted ion, and sometimes to greater intensity also. Emission intensity did not decrease monotonically with ion flux but reached a peak at an ion flux of 0.2 μA cm^{-2} for annealed cadmium sulphide samples. (auth)

19004 MAGNETO-OPTICAL STUDIES OF KCl:Tl AND KI:Tl AFTER X IRRADIATION AT 77K. Beaumont, J. H.; Hayes, W.; Laiho, R. T. S. (Oxford Univ.). J. Phys., C (London); 6: No. 24, L479-L481(11 Dec 1973).

The magnetic circular dichroism of KCl:Tl and KI:Tl was measured after x irradiation at 77°K. Results support earlier assignments of some optical absorption bands in the irradiated crystals to Tl^0 and Tl^{2+} ions; these valence states result from the capture of electrons and holes by Tl^+ ions. (auth)

19005 IMPROVEMENTS IN OR RELATING TO THE FORMATION OF ELECTRICALLY INSULATING LAYERS IN SEMICONDUCTING MATERIALS. Dearnaley, G.; Nelson, R. S. (to United Kingdom Atomic Energy Authority). British Patent 1,334,520. 17 Oct 1973. Filed date 12 Jun 1970. 4p.

A problem in the manufacture of semiconductor devices is the isolation of transistors and other components from the semiconducting material in, e.g., the manufacture of microelectronic devices. In the method described, the semiconducting material is formed with impurity atoms occupying substitutional sites in the crystal lattice, these atoms being capable, if released from their substitutional sites, of forming an electrically insulating material. The semiconducting material is subjected to ion bombardment, the ion type and energy being selected so as to create at the desired location for the insulating layer a region of radiation damage and to release impurity atoms from their substitutional sites. The material is then best treated so that the released impurity atoms precipitate to form the insulating material in the region of radiation damage. The ions employed may be protons, He ions, or C ions, and the material is subjected to electron irradiation simultaneously with or subsequently to the ion bombardment. An example is given whereby a region of insulating SiC is formed in a body of single-crystal Si. (UK)

19006 STANDARD SPECIFICATION FOR PLUTONIUM NITRATE SOLUTIONS. 1973 Annual Book of ASTM Standards. Part 7. Philadelphia; American Society for Testing and Materials (1973). 3p. (ASTM-C-710-72).

This specification covers nuclear-grade Pu nitrate prepared from Pu of different isotopic compositions, as is normally produced by in-reactor neutron irradiation of natural or slightly enriched uranium; ^{238}Pu used in isotopic heat sources is excluded. Requirements are included for chemical composition, sampling, packaging, handling, and shipping. (JRD)

19007 EFFECTS OF ELECTRON AND NEUTRON IRRADIATION ON THE ELECTRICAL PROPERTIES OF Si ON $MgO \cdot Al_2O_3$ SPINEL. Stein, H. J. (Sandia Labs., Albuquerque, NM). Solid-State Electron.; 16: No. 12, 1391-1397(Dec 1973).

The effects of electron and neutron irradiation on the electrical conductivity and Hall coefficient of n-type heteroepitaxial (Epi) Si/spinel were measured and compared to those for bulk vacuum-floating-zone (VFZ) silicon. A smaller degradation rate is observed for conductivity in Epi than in VFZ Si under irradiation. This effect is primarily due to a smaller mobility in Epi compared to VFZ Si, rather than to a lower defect production rate in Epi Si. Epi and VFZ Si exhibit similar carrier removal rates under irradiation, similar relative effects of electron and neutron damage, and similar annealing characteristics below 200°C which include the temperature for vacancy-phosphorus defect annealing. These similarities imply that a major fraction of the irradiation-induced defects are the same in irradiated Epi and VFZ Si at room temperature, even though extensive disorder in the "as grown" Epi Si drastically affects the pre-irradiation mobility. Thus, the inherent initial disorder in heteroepitaxial Si films does not necessarily increase radiation tolerance. (auth)

19008 CHANGE OF PHOTOLUMINESCENCE OF ZnS MONOCRYSTALS AS A RESULT OF REACTOR IRRADIATION. Kodzhespirov, F. F.; Andrianov, A. A.; Mozharovskii, L. A. Zh. Prikl. Spektrosk.; 19: No. 4, 636-640(Oct 1973). (In Russian).

Samples of ZnS monocrystals grown from melts under inert gas pressure were irradiated at 320°K with different fast neutron doses (ϕ) in the reactor. ϕ was varied from 3×10^{12} to 5×10^{17} neutrons/cm^2. The photoluminescent spectra were investigated in the region from 420 to 780 nm during uv excitation with λ_{max} = 365 nm at 300 and 77°K. At $\phi > 2 \times 10^{13}$ neutrons/cm^2, the intensity I of the photoluminescence decreases in all parts of the spectra. The brightness of the green band max ($\lambda_{max} \approx 525$ nm) decreases much faster than the blue ($\lambda_{max} \approx 466$ nm). These dependences are linearized well in the coordinates $I = f(\lg \phi)$. Above $\phi = 4 \times 10^{15}$ neutrons/cm^2, the photoluminescence at room temperature is almost completely quenched. The decrease of the photoluminescence is coupled with the decrease of the concentration of nonradiative recombination centers. The simultaneous destruction of luminescent centers is also possible. On some samples, small irradiation doses ($\phi < 2 \times 10^{13}$ neutrons/cm^2) intensify

the photoluminescence. As a rule these samples in the original state are very transparent and have weak photoluminescence. But the continued increase of the dose leads to a decrease of the luminescence intensity after reaching a maximum in the region $\phi = 2 \times 10^{13}$ neutrons/cm^2. The spectral composition of the photoluminescence of the self-activated samples does not vary during fast neutron irradiation. (tr-auth)

19009 RADIOLUMINESCENCE OF PRE-IRRADIATED LiF CRYSTALS. Kudelin, K. M. Zh. Prikl. Spektrosk.; 19: No. 4, 727-729(Oct 1973). (In Russian).

The radioluminescence of the thermoluminescent crystal LiF $I = I(D)$, previously irradiated with a large dose (up to 10^6 r) was studied. At a dose of $D > 2 \times 10^4$ r, the irradiation causes an increase of the radioluminescence and at $D \simeq 10^6$ r the relation $I = I(D)$ leads to saturation. By controllable annealing it was established that the increase of radioluminescence is caused by luminescent centers, lying at deeper energy levels than the capture levels corresponding to the thermopeaks at 140 and 180°C. The saturation of the dependence $I = I(D)$ caused the formation of color centers (at $D > 10^5$ r) which decreases the passage of the light characteristic of the luminescence of the crystal. (tr-auth)

19010 THERMAL CONDUCTIVITIES OF POLYMERS. I. Effects of Irradiation. Imura, S.; Takegoshi, E.; Nagamoto, T. (Toyama Univ., Takaoka, Japan). Toyama Daigaku Kogakubu Kiyo; 24: No. 1-2, 41-44(Mar 1973). (In Japanese).

Thermal conductivities of several kinds of polymers were measured at 25 to 85°C by the steady-flow method. In the thermal conductivity curve of nonirradiated amorphous polymers, a bend at their glass transition temperature was found. In the irradiated samples, this bend was not found in the present experiments. The thermal conductivities of crystalline polymers decreased with increasing temperature. In the irradiated samples, the thermal conductivities tended to become higher than those of nonirradiated samples because of the increase of density, but above their softening points, the values became lower than those of nonirradiated samples. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 18034, 18075, 18240, and 18242.

19011 (GULF-RT-A-12464) APPLICATION OF PHOTO-INDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Final Report, July 1, 1971–October 31, 1972. Rundquist, D. E.; Bramblett, R. L.; Costello, D. G.; Ginaven, R. O.; Naliboff, Y. D.; Weber, H.; Sund, R. E. (Gulf Radiation Technology, San Diego, Calif. (USA)). 15 Oct 1973. Contract AT(04-3)-167. 129p. Dep. NTIS $5.45.

Research and development performed on techniques and application of nondestructive measurements of nuclear reactor fuel materials by Intelcom Rad Tech during the period July 1, 1971 to October 31, 1972, are reported. For this work a mobile assay system (GAMAS), was designed and built in previous contract periods. GAMAS includes a 9-MeV electron accelerator (Linac), a high-efficiency neutron detector and sample scanner for containers up to 55 gal in volume, gamma-ray detectors, an on-line computer, and a ^{252}Cf based assay device, ISAS. GAMAS was operated extensively during this reporting period. Four locations were visited in the states of Idaho, Pennsylvania, and two in Ohio. A very great variety of nuclear material forms were encountered, including plutonium metal, plutonium oxide, plutonium fluoride, uranium metal, uranium oxide, and uranium fluoride. The uranium enrichment in ^{235}U varied from natural enrichment (0.7%) to fully enriched (97%). Sample containers ranging from small cans (<1-qt.) to 55-gal barrels and complete fuel assemblies were measured. It has been shown that even for this wide variety of material, most nuclear waste can be assayed to an accuracy of ±15% or better. More homogeneous products or recoverable scrap have been assayed to an accuracy of 1% or better under field operating conditions. (auth)

19012 (NP-19932) IMPROVEMENTS NEEDED IN THE PROGRAM FOR THE PROTECTION OF SPECIAL NUCLEAR MATERIAL. (General Accounting Office, Washington, D. C. (USA)). 1973. 52p. General Accounting Office, Washington, DC. $1.00.

The US General Accounting Office (GAO) reviewed the AEC's program for the in-plant protection of special nuclear materials, i.e., fissionable Pu and U, held by organizations authorized to possess it. The findings and recommendations to both the USAEC and the US Congress for improving the in-plant physical protection of special nuclear materials are presented. Inadequacies in the equipment, requirements, and inspection practices are listed. Recommendations are made that the AEC upgrade its protection requirements, impose protection requirements on holders of unclassified material, define the capabilities of an effective protection system, and improve inspection practices. The AEC generally agreed with the GAO recommendations and is taking actions to implement them. (LCL)

19013 (REG/G-5.7(6-73)) CONTROL OF PERSONNEL ACCESS TO PROTECTED AREAS, VITAL AREAS, AND MATERIAL ACCESS AREAS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 9p. DRS.

This guide describes acceptable methods of searching personnel prior to entry into a protected area and upon exit from a material access area, and of controlling access to protected areas, vital areas, and material access areas. (TFD)

19014 (REG/G-5.10(7-73)) SELECTION AND USE OF PRESSURE-SENSITIVE SEALS ON CONTAINERS FOR ON-SITE STORAGE OF SPECIAL NUCLEAR MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jul 1973. 3p. DRS.

Pressure-sensitive seals on containers used for onsite storage of SNM are passive devices that indicate, upon inspection, whether tampering or entry has occurred. These seals may also serve as labels. This guide provides criteria acceptable to the USAEC Regulatory staff for selecting, affixing, and testing pressure-sensitive seals used for tamper-safing in connection with the onsite storage of SNM for compliance with the Commission's regulations with respect to material control. (TFD)

19015 (REG/G-5.11(10-73)) NONDESTRUCTIVE ASSAY OF SPECIAL NUCLEAR MATERIAL CONTAINED IN SCRAP AND WASTE. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1973. 15p. DRS.

This guide details procedures acceptable to the USAEC Regulatory staff to provide a framework for the utilization of nondestructive analysis (NDA) in the measurement of scrap and waste inventory components generated in conjunction with the processing of special nuclear materials (SNM). (TFD)

19016 APPLICATION OF X-RAY SPECTROSCOPY FOR THE IDENTIFICATION OF SEALS USED AS A SAFEGUARDS TOOL. Toussaint, C. J.; Vos, G. (Commission of the European Communities, Ispra, Italy). Atomkernenergie; 22: No. 2, 139-141(Oct 1973).

X-ray spectroscopy has been studied as an identification method for sealing devices, used in the safeguarding of nuclear materials. This method is based upon the identification of artificial metallic inclusions randomly distributed in a solid matrix (e.g., aluminium), followed by the establishment of an "x-ray fingerprint". This x-ray fingerprint is composed of the ratio between the intensities of the x-ray spectral lines of the inclusions and the coherent scattered radiation of the x-ray tube. Depending on the kind of elements and their concentrations, a particular x-ray chart is obtained, which is quite impossible to reproduce. (GE)

19017 ORGANIZATION OF THE INVENTORY OF FISSILE MATERIALS. Speeckaert, P.; de Backer, J. Mol, Belgium; Centre d'Etude de l'Energia Nucleaire (1973). 18p. (In French).

Regulation No. 8, in pursuance of the Euratom treaty, obligates the member states to declare regularly the fissile material which they hold. Consequently, the Belgian firms and the CEN/SCK particularly must declare the totality of the fissile material stocks which they hold. These monthly declarations impose the bookkeeping of the inventory in such a manner that at any moment it is possible to indicate the stock of fissile material and to determine the locality at which it is found so as to permit a physical check. The control authorities have also the authority to verify the weights of lots and to sample a part for chemical or isotopic analysis. Within the framework of these obligations the CEN/SCK maintains a bookkeeping following the standards required by the Regulations of the Euratom treaty. (tr-auth)

19018 MEASUREMENTS OF UF6 CYLINDERS WITH PORTABLE INSTRUMENTS. Walton, R. B. (Los Alamos Scientific Lab., NM); Reilly, T. D.; Parker, J. L.; Menzel, J. H.; Marshall, E. D.; Fields, L. W. Nucl. Technol.; 21: No. 2, 133-148(Feb 1974).

The applicability of portable instruments for rapid nondestructive verification of the enrichment of UF_6 in cylinders has been tested on a large number of Types-30 and -5A cylinders. Three basic techniques were used: (1) gamma-ray counting with NaI, combined with ultrasonic measurement of cylinder wall thickness, (2) passive-neutron counting, and (3) active-neutron interrogation with thermal neutrons from a radioactive neutron source. The accuracy of the gamma-ray method was ~5% for Type-30 cylinders of UF_6 and 2% for highly enriched UF_6 in Type-5A cylinders; however, the method occasionally failed for Type-30 cylinders because of background from nonvolatile daughters of ^{238}U plated on the cylinder walls. The standard deviation of enrichments of 110 Type-30 cylinders, derived from passive-neutron counting data by assuming a constant ^{235}U/^{234}U ratio, is 6%. The response of the active system increases almost linearly with enrichment up to ~2.5% ^{235}U and then saturates at ~4%. (auth)

Disposal and Storage

Refer also to abstracts 18057, 18230, 18348, 18350, 18366, and 18379.

19019 (ARH-2915) NUCLEAR REACTIVITY EVALUATIONS OF 216-Z-9 ENCLOSED TRENCH. Smith, A. E. (comp.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Dec 1973. Contract AT(45-1)-2130. 256p. Dep. NTIS $15.00.

Plutonium and americium accumulations and the nuclear criticality implications were evaluated for an underground liquid waste disposal site at Hanford, Washington. Remote plutonium detection by infrared, gamma, and neutron surveys is described. Geological drilling and soil sampling techniques developed are described. Nuclear criticality safety was evaluated by computer model calculations and by neutron pulsing techniques. Technologies used to evaluate a waste disposal site for a plutonium recovery operation are discussed, and sampling equipment and procedures are described in detail. (auth)

19020 (HW-70806-RD) CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS, JANUARY–JUNE 1961. Haney, W. A. (ed.). (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 28 Aug 1961. Contract AT(45-1)-1350. 21p. Dep. NTIS $3.25.

Research during Jan. to July 1961 related to the underground disposal of radioactive wastes from the Hanford Atomic Products Operation is described. Data from monitoring ground water in the 200 West Area is presented and compared with precious gross beta-activity measurements. Progress is reported on: waste tank leak detection; treatment of condensation wastes; Pu-removal from 234-5 Building waste; elution of Cs from beds of clinoptilolite; disposal of NPR decontamination wastes; fission product release experiments; and use of aluminum beds for decontaminating reactor effluent. (LCL)

19021 (IDO-10054(72)) NATIONAL REACTOR TESTING STATION RADIOACTIVE WASTE MANAGEMENT INFORMATION, 1972 SUMMARY AND RECORD-TO-DATE. (USAEC Idaho Operations Office, Idaho Falls). [nd] 21p. Dep. NTIS $3.25.

This report summarizes radioactive waste records associated with activities at the National Reactor Testing Station for 1972. Summary data since 1952 are included. The volumes, radioactivity, isotopic identification, origin of waste and decay data are given. The waste data have been taken from the NRTS Waste Management Information System and are in computer printout form. (auth)

19022 (SLA-73-931) APPROXIMATE SOLUTION FOR SELF-BURIAL RATES OF RADIOACTIVE WASTE CONTAINERS. Hardee, H. C.; Sullivan, W. N. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 19p. Dep. NTIS $3.00.

An approximate solution has been developed that predicts the migration velocity of a finite spherical heat source melting through an infinite medium. Experimental data agree well with theoretical predictions. (auth)

19023 (TID-26524) MANAGEMENT OF RADIOACTIVE WASTES AT THE SAVANNAH RIVER PLANT. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Plant). 1969. 63p. Dep. NTIS $5.25.

Seven papers that were given before the Committee on Radioactive Waste Management of the National Academy of Sciences are presented. Topics discussed include: (1) general technical introduction and description of the site; (2) radioactivity released to the environs—control guides and experience; (3) contaminated water from the reactor areas; (4) disposal of radioactively contaminated solids and slightly contaminated water; (5) the nature, handling, and storage of separations process wastes; (6) design and construction criteria for facilities to handle highly active liquid waste; and (7) long-term storage of highly active wastes in bedrock caverns. (TFD)

19024 INTERNATIONAL HIGH LEVEL NUCLEAR WASTE MANAGEMENT. Dreschhoff, G.; Saunders, D. F.; Zeller, E. J. Bull. At. Sci.; 30: No. 1, 28-33(Jan 1974).

A uniform international policy does not exist for disposal of highly radioactive waste products from nuclear reactor fuel reprocessing. In November, 1972, the Nuclear Energy Agency of the OECD and the IAEA held a meeting to discuss the problems of management of radioactive wastes and the policies in Belgium, India, Canada, France, German Federal Republic, Italy, Japan, USA, USSR, and the United Kingdom are presented. The practices can be divided into storage or disposal—storage implying some form of temporary confinement in containers or structures and from which it can be readily recovered and disposed of by applying procedures involving emplacement of the wastes in geologic formations. (MCW)

19025 TECHNICAL AND SOCIAL ASPECTS OF NUCLEAR WASTE DISPOSAL IN WESTERN EUROPE. Rose, D. J.; Tenaglia, G. Ambio; 2: No. 6, 233-240(1973).

Disposing of radioactive wastes from nuclear reactors poses combined technical and social problems. Useful new technical options seem available (e.g., perhaps eliminating very long-lived wastes from the stored burden by recycling them in the reactors). Social issues need more attention; it is suggested that, as a minimum, each nation opting for nuclear power be prepared to accept its processed wastes for storage, because individual states and their successors have greater continuity than do international institutions. With that base, international agreement will more easily follow. (auth)

19026 UP-TO-DATE FACILITIES FOR RADIOACTIVE WASTE DISPOSAL IN CZECHOSLOVAKIA, POLAND, AND THE USSR. Pavlik, O. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Izotoptechnika; 16: No. 12, 663-673(Dec 1973). (In Hungarian).

Waste disposal facilities and methods, used in Rez, Swierk, and Moscow and in the decontamination station in Zagorsk, are described. (auth)

19027 SELECTION OF A GROUND DISPOSAL SITE BY SENSITIVITY ANALYSIS. Morisawa, S.; Inoue, Y. (Kyoto Univ.). Health Phys.; 26: No. 3, 251-261(Mar 1974).

Disposal of radioactive wastes in the ground is not allowed in Japan at present mainly because of the difficulties in estimating the ground migration of radionuclides and in evaluating the internal dose caused by these wastes. The desirable conditions for the ground disposal of radioactive wastes and the approximate method for estimating the internal dose are discussed by means of a sensitivity analysis. Eighteen out of some 26 factors in the three ecological paths through which leaked radionuclides migrate (i.e., drinking water, seafoods, and plants) are quantitatively examined by sensitivity analysis. The relationships between the internal dose and the many factors concerned are shown in tables. The difference between strict calculation and approximation of internal dose is also examined. The approximation is shown to be useful especially for the quick estimation of the safety of a site for the ground disposal of radioactive wastes. (auth)

Handling Equipment and Procedures

19028 (GAT-DM-1235) PRELIMINARY REPORT ON GAMMA SPECTROMETER ENRICHMENT MONITOR AND NEUTRON PROBE ENRICHMENT MONITOR. Feuerbacher, J. L. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 29 Jun 1973. Contract AT(33-2)-1. 8p. Dep. NTIS $3.00.

A gamma spectrometer enrichment monitor and a neutron probe enrichment monitor have been installed at the No. 2 Extended Range Product Station, on the line between the 8" I.D. liquid UF_6 accumulator and the valve going to the withdrawal cylinder. Both instruments appear to be satisfactory as enrichment monitors, from the standpoint of nuclear criticality safety. The monitors will continue to be operated on an experimental basis for the near future. Eventually a decision will be made as to final disposal. (TFD)

19029 (GAT-T-1917) PRELIMINARY TESTS OF A GAMMA SPECTROMETER AS AN ENRICHMENT MONITOR IN THE EXTENDED RANGE PRODUCT STATION. Feuerbacher, J. L. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 5 Oct 1972. Contract AT(33-2)-1. 8p. Dep. NTIS $3.00.

A Ludlum gamma spectrometer was installed in the Extended Range Product Station with necessary auxiliary electronic components and printout system, to monitor ^{235}U enrichment. The probe was mounted under the insulated 8" I.D. accumulator line of the No. 2 Station. Data were collected in the original orientation for several weeks; then the probe was moved to a position underneath a new 1" monel line which had been installed inside the pipe housing. The new line was installed to bypass an existing block valve on the liquid UF_6 drain line to the withdrawal cylinder to assure that a constant volume of UF_6 would be monitored. Data were taken in this position for four days. Then the equipment was returned to LASL. The gamma spectrometer probe should be satisfactory as an enrichment monitor for nuclear criticality safety purposes. Installation of a more permanent unit is recommended, to allow further study and perhaps serve as a permanent assay monitor on one of the systems. (TFD)

19030 (REG/G-3.10(6-73)) LIQUID WASTE TREATMENT SYSTEM DESIGN GUIDE FOR PLUTONIUM PROCESSING AND FUEL FABRICATION PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 3p. DRS Washington, DC Free.

Operation of plutonium processing and fuel fabrication plants may include a variety of scrap processes, processing equipment, and techniques to recover the plutonium content of all but low-level scrap generated in manufacturing operations. In most cases, the liquid wastes from these scrap processes and contaminated liquids from other plant areas are treated by a radioactive liquid waste treatment system. Since this is the last treatment step prior to the release of waste materials from the facility, careful selection of the methods of treatment and processing components should be made not only to confine radioactive material under normal and credible accident conditions but to reduce the radioactivity of waste materials to the lowest practicable level. This guide describes engineering criteria for the design of principal components of the radioactive waste treatment systems for these facilities. (TFD)

19031 (REG/G-3.15(10-73)) STANDARD FORMAT AND CONTENT OF LICENSE APPLICATIONS FOR STORAGE ONLY OF UNIRRADIATED REACTOR FUEL AND ASSOCIATED RADIOACTIVE MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1973. 3p. DRS.

This guide presents a format and a description of content of

an application for a license to authorize the receipt, possession, and storage of unirradiated fuel assemblies and associated radioactive materials for eventual use in a nuclear reactor that are acceptable to the AEC Regulatory staff. (TFD)

19032 (RT/ING-(73)4) LABORATORIES AND TECHNIQUES FOR RESEARCHES ON IRRADIATED FUELS. Cesarano, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 May 1973. 158p. (In Italian). Dep. NTIS (U.S. Sales Only) $10.00.

The hot laboratories and related problems are widely described in the scientific literature, however, most of the papers concerning this matter is scattered in various publications or in the proceedings of specialized conferences. The main purpose of this report is to treat the whole matter with special reference to the hot laboratories devoted to post-irradiation examination of irradiated fuel elements. Therefore, problems associated with remote handling of radioactive elements are discussed as well as problems of analytical procedures. The post-irradiation work is emphasized as well as the research and development on fuel elements. (auth)

Transportation

19033 (ORNL-TM-3503) LMFBR SPENT FUEL TRANSPORT: PARAMETRIC STUDIES. Nichols, J. P.; Irvine, A. R.; (Oak Ridge National Lab., Tenn. (USA)). Feb 1972. Contract W-7405-eng-26. 138p. TIC $9.00

A computer code (LMYRA) was developed to aid in the parametric analysis of LMFBR spent fuel shipping casks. Subject to imposed technical restrictions on temperatures within the cask and total cask weight, the code generates minimum cost designs for a variety of shield and coolant materials and fuel containment concepts. Calculations made for shipment of spent fuel from the Atomics International Follow-On LMFBR indicate that minimum costs would result from the shipment of uncanistered fuel using an internal coolant of sodium in a steel-shielded cask. If the fuel must be contained in welded canisters because of the possibility of failure of cask seals, lowest costs would result from the use of a sodium coolant inside the canisters and either air or nickel shot outside the canisters. These conclusions were not changed by credible variations of the economic assumptions, imposed limits on allowable temperatures within the cask, and the type of LMFBR fuel element. (auth)

19034 TRANSPORT OF RADIOACTIVE SUBSTANCES. Schulz-Forberg, B. (Bundesanstalt fuer Materialpruefung, Berlin). Amts-Mitteilungsbl. Bundesanst. Materialpruef.; 2: No. 3, 99-101(1972). (In German).

The IAEO recommendations of 1961 together with the First Radiation Protection Ordinance of 1960 are the development basis of regulations for the requirements for containers of radioactive materials. The different container types according to the degree of their criticality risks are described. The requirements to be assumed for type B packages requiring a license are discussed. (GE)

19035 CIVIL LIABILITY FOR NUCLEAR DAMAGE IN THE FIELD OF MARITIME TRANSPORT OF NUCLEAR MATERIALS ACCORDING TO THE CONVENTION OF LONDON, DECEMBER 17, 1971. von Welck, S. Versicherungsrecht; 23: No. 13, 313-317(1972). (In German).

The Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material which was held in Brussels on December 17, 1971 has since been signed by eight states, among them the FRG. Thus the international law on liability for nuclear damage has been extended by another agreement. It is equal to the four hitherto existing conventions (namely the Vienna Convention, the Paris Convention, the Convention supplementary to the Paris Convention, and the Brussels Convention on the liability of operators of nuclear ships) and is in compliance with the system of liability set up in these preceding conventions. Its purpose is to supplement them with regard to the liability for nuclear damages in the field of maritime carriage of nuclear material. (GE)

19036 PACKAGING AND TRANSPORTATION OF RADIOACTIVELY CONTAMINATED BIOLOGICAL MATERIALS. New York; American National Standards Institute, Inc. (1973). 12p. (ANSI-N-14.3-1973).

This standard recommends methods and procedures for the preparation, packaging, and transportation of radioactive materials contained in biological materials. The standard is applicable to the packaging and transport of not more than Type A quantities of radioactive materials as defined by U.S. Department of Transportation (DOT) Regulations [49 CFR 173.389]. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 19675, 19694, 19739, and 19900.

19037 (AECL-4654) SUPERCONDUCTING HEAVY ION CYCLOTRON. Bigham, C. B.; Fraser, J. S.; Schneider, H. R. (Atomic Energy of Canada LTD., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

A post-tandem cyclotron with superconducting coils to provide the magnetic field is proposed for the production of 10 MeV/A heavy ions and up to 50 MeV/A light ions. NbTi superconducting coils provide an average field of 5T out to a 0.65 m extraction radius. Flutter focussing ($B_H - B_V = 1.6T$) is provided by 4 saturated iron sectors with spiral edges. The accelerating voltage per turn (0.6 to 0.8 MV) required for single turn extraction is provided by an eight gap structure mounted on two coupled axial $\lambda/4$ resonators. A wide range of specific energies (3 to 50 MeV/A) is obtained by operating the resonators either in phase (O-mode) or out of phase (π-mode) over the 22 to 45 MHz frequency range. Ions are injected on the midplane to a stripper foil at the inner orbit (~0.15 m radius). Electrostatic deflectors and a magnetic channel provide single turn extraction. (auth)

19038 BATAVIA ACCELERATOR. Wilson, R. R. (National Accelerator Lab., Batavia, IL). Sci. Amer.; 230: No. 2, 72-83 (Feb 1974).

The Illinois accelerator is currently accelerating protons to energies up to 400 GeV. Its designers hope to reach 1000 GeV with a new superconducting magnet ring. The facility, its operation and uses are described. (TFD)

19039 GRAPHO-ANALYTICAL INVESTIGATION OF DEPENDENCE OF ELECTRON ENERGY DISTRIBUTION ON BEAM PARAMETERS OF HIGH-CURRENT ACCELERATORS OF THE TRANSFORMER TYPE (ELT-1.5 AND ELT-2.5). Abramov, K. K.; Braginskii, R. P.; Kovalev, G. P.; Polykov, A. A.; Finkel, E. E.; Fridman, V. I. pp 30-35 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Calculations and investigation of the electron energy distribution were made as a function of the current and voltage in the accelerating tubes for accelerators of the ELT-1.5 and ELT-2.5 types. Experiments on the measurement of the current attenuation of the electron beam passing through a set of metallic filters were used in the calculations. It was shown that the measurement of the beam current caused a change in the energy distribution but at constant maximum beam energy the character of the dependence of the energy distribution does not change in the first approximation. At a given beam current with increase of the voltage in the accelerating tubes a scaling expansion of the energy spectra graphs occurs. (tr-auth)

19040 DOSIMETRY OF THE ELECTRON BEAM OF A COAXIAL ACCELERATOR. Muminov, V. A.; Shubin, I. V.; Zolotarevskaya, F. T. pp 62-66 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The construction of a coaxial electron accelerator with radially uniform distribution of the dose field is described. With use of a polyethylene dosimeter the volume distribution of the dose field along the normal and parallel to the electron motion was obtained. The relative distribution of the absorbed dose in polyethylene films was also determined according to the scanning length of the circumference of the cylinder on which this film is fastened. (tr-auth)

19041 DISTRIBUTION OF ABSORBED DOSE ACCORDING TO THICKNESS OF POLYMETHYLMETHACRYLATE DURING DIFFERENT METHODS OF IRRADIATION WITH ELECTRON BEAMS FROM U-16 AND U-13 ACCELERATORS. Nikulin, K. I.; Kukhtina, L. M.; Ziganshin, O. Z. pp 66-68 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A method is described for the determination of the absorbed dose field according to the thickness of the electron-irradiated polymethylmetacrylate. On the basis of the data obtained, an irradiation regime assuring the uniformity of the absorbed dose field according to the thickness of the irradiated object, is proposed. (tr-auth)

Auxiliaries and Components

19042 INCREASING THE DIELECTRIC STRENGTH OF ACCELERATOR TUBES. Khirnyi, Yu. M.; Solodovnikov, A. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1012-1014 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 228-230(1973).

The results of investigations of an accelerator-tube element having electrodes that are irradiated by helium ions are described. It is shown that the dielectric strength of such an element (120 kV/cm) is double that of the dielectric strength of an element having nonirradiated electrodes (60 kV/cm). (auth)

19043 COMPARATIVE EVALUATION OF CHARGE TRANSPORTERS AND CHARGING SYSTEMS OF AN ELECTROSTATIC GENERATOR. Ryabov, L. I.; Beruchev, N. G.; Uspenskii, V. B. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1015-1017(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 31-32(1973).

Various constructions of charge transporters and charging systems of an electrostatic generator were investigated. Results are presented of investigations on the contact and corona method of depositing and removing charges from the tape. Several types of tapes are considered. The advantages of the contact method of depositing and removing charges are demonstrated. (auth)

19044 STABILIZATION OF THE RESONANT FREQUENCY AND ELIMINATION OF THE VOLTAGE ASYMMETRY OF THE DEE TUNED CIRCUIT OF A CYCLOTRON. Biryukov, N. S.; Zhuraviev, B. V.; Piyaskin, V. I.; Sal'nikov, O. A. (Physics-Power Inst., Obninsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1008-1011(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 25-28(1973).

A transistorized device is described which allows automatic tuning of the resonant frequency of the dee tuned circuit and elimination of the asymmetry of the accelerating voltage of a cyclotron. The device is used in the operation of a cyclotron as a pulsed source for neutron spectrometry by the time-of-flight method and permits the parameters and stability of the spectrometer to be improved. (auth)

19045 IMPROVEMENT OF THE MONOENERGETICITY OF A CYCLOTRON BEAM. Krasnov, N. N.; Mironov, V. N.; Ognev, A. A. (Physics-Power Inst., Obninsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1005-1007(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 22-24(1973).

An investigation was carried out of the effect of collimation of the beam on the first revolution, stabilization of the voltage across the dees, and likewise of the effect of the operating mode of the ion source on the width of the energy distribution of the extracted cyclotron beam. A beam of He ions was obtained having an energy distribution width of 0.2% at an energy of 45.2 MeV and an average value of the current in the extracted beam equal to 2.5 μA. The measurements were carried out on the 1.5 meter cyclotron of the Physics-Power Institute. (auth)

19046 IZMERENIE POLNOI ENERGII PUCHKOV TORMOZNOGO IZLUCHENIYA OT ELEKTRONNYKH USKORITELEI. (Measurement of the Total Energy of Bremsstrahlung Beams From Electron Accelerators). Komar, A. P.; Kruglov, S. P.; Lopatin, I. V. Leningrad; Izdtel'stvo Nauka (1972). 215p.

Experiments on the accurate measurement of the total energy of bremsstrahlung beams from electron accelerators are generalized. The different methods used for this type of measurement, e.g., calorimetric, scintillation, and ionization, are described. The comparative characteristics of these methods are given and means for their continued improvement are examined. Special attention is given to the quantometer which is the most promising instrument for the absolute measurement of the energy of bremsstrahlung beams. The results of the comparison of its reading with other absolute methods in the energy range from 5 MeV to 5 GeV are reported. Special ionization chambers used as secondary standards are also described. Extensive tables of the attenuation coefficients of γ radiation are given for the energy range from 10 keV to 100 GeV. The energy loss and the mean free path of electrons at energies from 10 keV to 1 GeV are also tabulated. (tr-auth)

19047 SYSTEM FOR THE PRECISE MEASUREMENT OF THE CHARGE OF A PULSED ELECTRON BEAM. Zapevalov, V. A.; Ponomarev, V. N.; Reingardt-Nikulin, P. I. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 135-137(1973). (In Russian).

A system for the measurement of the charge of a pulsed electron beam during experiments with a precision of better than 0.5% is described. The basic parameters of the individual elements of the system are reported. (tr-auth)

19048 MEASUREMENT OF THE EFFICIENCY OF SECONDARY EMISSION MONITORS. Ponomarev, V. N. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 116-119(1973). (In Russian).

The experimental investigation of the basic parameters of secondary emission monitors with emitters of Al, Co, and Fe is described. The measurements were made with the beam from the electron linear accelerator in the energy range of primary electrons from 7.5 to 10 MeV. A Faraday cylinder was used for the absolute measurement of the intensity of the electron beam. The efficiency of the Faraday cylinder was determined experimentally. The basic parameters of the secondary emission monitor are reported. (tr-auth)

19049 THYRATRON DISCHARGER OF THE KLYSTRON MODULATOR OF THE LU-50 ELECTRON LINEAR ACCELERATOR. Mel'nikov, V. V.; Telezhnikov, V. N. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 112-115(1973). (In Russian).

The circuit of the discharger in two hydrogen thyratrons is reported and compared with dischargers of analogous types. (tr-auth)

19050 CALORIMETRIC MONITORING SYSTEM FOR LOW DUTY CYCLE BEAMS. Barbini, R.; Faini, S.; Guaraldo, C.; Schaerf, C.; Scrimaglio, R. (CNEN, Frascati, Italy). Nucl. Instrum. Methods; 115: No. 1, 85-87(1974).

A calorimetric monitoring system for the LNF-LEALE low energy pion beams is described. The apparatus measures the energy dissipated by the photons in the pion source with thermometric techniques. Numerical manipulation of the source temperature yields a relative but very stable monitor. (auth)

19051 COMPACT BEAM SCANNER IN IMMEDIATE VICINITY OF THE TARGET. Duport, J. L.; Jaccard, S. (Univ., Neuchatel, Switzerland). Nucl. Instrum. Methods; 115: No. 1, 233-234(1974).

A beam scanner is described. Its compactness allows one to get the beam position and the charge profile in the x and y directions very near the target without having to substantially increase the diameter of the beam guiding tube. (auth)

19052 MEASUREMENT OF PARAMETERS OF THE ELECTRON BEAM IN THE ACCELERATION CHAMBER OF A HIGH-CURRENT 25-MeV BETATRON. Moskalev, V. A.; Shashov, V. V.; Sergeev, G. I. pp 18-22 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The direct measurement of the electron current with targets at low discharge phase of the electron with the orbit was achieved. The transverse dimensions of the beams were determined by the three target method. Two of the targets were placed in the acceleration chamber above and below the median plane and have the property of rotational and radial motion. The third intersects the median plane. The radial dimensions of the beam were measured with respect to the rate of broadening of the orbit and the longitudinal pulse of the radiation with the target. (tr-auth)

19053 SYSTEM FOR MEASUREMENT OF CURRENT OF A CONTINUOUS BEAM OF CHARGED PARTICLES WITHOUT INTERRUPTING IT. Moskalev, V. A.; Tsimbalist, A. V.; Shestakov, V. G. pp 22-24 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A system is described for the measurement of the current of a continuous beam using an electrostatic electrode and a ferroelectric transformer. The system is simple in design and makes it possible to measure both weak and strong currents. (tr-auth)

Ion Sources and Injection and Extraction Systems

19054 PARALLEL FLOW OF CYLINDRICAL BEAMS OF CHARGED PARTICLES. Bosi, G. (Univ. of Moncton, New Brunswick). J. Appl. Phys.; 44: No. 9, 3990-3992(Sep 1973).

The usual geometry of an axially symmetric parallel flow Pierce-type gun is discussed and some shortcomings underlined. The general equation defining the family of field forms ensuring parallel flow is carried out and a particular solution selected. The shape of electrodes providing the chosen field form is calculated in a simple and reliable way. (auth)

19055 MODERNIZATION OF A SYSTEM FOR LOCAL PERTURBATION OF THE ORBIT FOR PURPOSES OF UNIFORM EXTRACTION OF PARTICLES. Esin, S. K.; Kovalenko, V. I.; Markar'yan, A. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1002-1004(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 20-22(1973).

An improved system for extracting γ beams using the Erevan synchrotron is described. The half-sinusoid pulse in the windings of the extraction system is replaced by a pulse having a special shape. The circuit that shapes such a pulse is given and described. Production of γ quanta with stretching to 2 msec is obtained which is uniform in intensity (with an accuracy $\pm 10\%$). The particles are extracted symmetrically relative to the maximum of the guiding magnetic field. (auth)

19056 GYROMAGNETIC COMPRESSION OF POWERFUL RELATIVISTIC DENSE ELECTRON FLOWS OF TUBULAR FORM. Levin, M. L.; Minta, A. L.; Naumenko, E. D.; Filimonova, T. N. (Commission on Charged Particle Acceleration, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 5, 1085-1088(11 Aug 1973). (In Russian).

A method for compressing sections of a tubular electron current was studied in which the tube was reconstructed to a rotating ring, movable along the electron axis. The rings were radially compressed in the spatially increasing static magnetic field. The compressed ring was re-formed in the flying axis of the section of the tubular electron current, differing from the original by having smaller dimensions and higher density. The results of the investigation suggested possibilities for further control of electron movement. Examples are supplementary hydromagnetic compression with incomplete conversion of relativistic linear movement to rotation, scanning along the target, and focusing on a small target by using the static magnetic field spatially increasing from zero. (TTT)

19057 STUDY OF THE LONGITUDINAL AND TRANSVERSAL ACCEPTANCE FOR POSITRONS IN A LINEAR ACCELERATOR. Debeuckelaer, C. L. Ghent; Ghent State Univ. (1973). 138p. (In Dutch).

Thesis.

After a description of the functioning of a linear accelerator, the equations for the movement of an electron and positron beam and the rate of formation of positrons are given. By varying the various focusing and acceleration parameters the maximum efficiency is calculated. (tr-auth)

19058 ION SOURCE FOR HIGH-INTENSITY METAL IONS. Hudson, E. D.; Mallory, M. L.; Lord, R. S. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 115: No. 1, 311-312(1974).

A simple method of producing high-intensity metal ion beams from a high-powered Penning ion source in a cyclotron is described. (auth)

19059 ALIGNMENT OF THE FOCUSING COIL OF THE INJECTOR SECTION OF THE ELECTRON LINEAR ACCELERATOR BY THE STEEP ASCENT METHOD. Verbitskii, G. B.; Dzhilavyan, L. A.; Zakharov, V. N. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 132-134(1973). (In Russian).

The method of extreme programming of the experiment was used for the alignment of the focusing coil of the injector section of the electron linear accelerator. A model of the programming matrices is reported. An operational alignment of the coil was attained with the necessary precision. (tr-auth)

Ion Optics and Field Calculations

Refer also to abstracts 18490 and 19454.

19060 (UCRL-Trans-1508) STABILITY OF COHERENT OSCILLATIONS OF AN ELECTRON RING IN RESONATOR. Part II. Transverse Oscillations. Aleksakhin, Yu. I.; Korenev, I. L.; Yudin, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. Translated by G. Brodell from JINR-P4-7066. 40p. Dep. NTIS $4.00.

Resonance and resistance instabilities of transverse oscillations of a beam in a cylindrical resonator were studied. It is shown that the most dangerous are the lowest resonance modes of axial oscillations. (auth)

19061 SCATTER FOCUSSING OF MULTI-GeV CHARGED PARTICLES AND NEUTRAL HADRONS. Jones, L. W.; Koch, D. G. (Univ. of Michigan, Ann Arbor). Nucl. Instrum. Methods; 115: No. 1, 125-133(1974).

The multiple Coulomb scattering of charged particles and the nuclear elastic scattering of neutral hadrons may serve as a basis for the design of lenses for beams of such particles. The optical and spectral properties of such lenses are explored and numerical examples are given. (auth)

19062 SOME VARIANTS OF THE ACHROMATIC ROTATING-ANALYZING SYSTEM. Dzhilavyan, L. Z.; Oboznyi, V. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 120-124(1973). (In Russian).

A calculation is made of the eight possible variants of the achromatic rotating-analyzing system, having mirror symmetry, with converging beams in the parallel and in the horizontal and vertical planes, and consisting of a minimum number of elements. A comparison is made of the different variants from conditions of maximum assumed phase space and some other characteristics of the system. (tr-auth)

19063 PROGRAM LIBRARY FOR THE CALCULATION OF AN ELECTRON-OPTICAL SYSTEM. Oboznyi, V. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 129-131(1973). (In Russian).

A description is given of a program library recorded on magnetic tape in the FIAN computer. It is easy to use for the calculation of the electron-optical system and different characteristics of a charged particle beam transported in a magnetic system. Instructions for the use of the library are given. (tr-auth)

19064 INTERACTION OF IONS DURING ACCELERATION IN THE CYCLOTRON. Kazarnovskii, M. V.; Moroz, E. M. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 49-73(1973). (In Russian).

The transverse and longitudinal effects of the space charge in the spectrometric isochronous cyclotron were examined. It was shown that the transverse effects are not hazardous for the normal operation of the accelerator, whereas the longitudinal Coulomb interactions of the ions leads to significant deviation of the ion energy occurring at the end of each bunch in which the basic contribution to the longitudinal Coulomb effect introduces the electric field of the multi-orbit bunch. The induced charge on the horizontal walls of the dee and chambers very sharply weakens the longitudinal Coulomb effect in the central part of the bunch but affects its edge very little. During some physical experiments during which undesirable, even though small, admixtures of ions with energies below the limits of the desired dispersion, it was necessary to eliminate the bunch ends coming from the cyclotron. (tr-auth)

19065 SOME QUESTIONS OF PARTICLE DYNAMICS IN ISOCHRONOUS SECTOR CYCLOTRON. Khokhlov, Yu. K. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 74-94(1973). (In Russian).

The accelerated motion of particles in the median plane of the isochronous cyclotron was examined. The accelerating slits are considered infinitely narrow. The concept of an ideal trajectory, having the property that its steps along any radius do have the usual precession oscillations, was introduced. A system of linear equations describing the phase and betatron oscillations of this trajectory with reference to the corresponding ideal trajectory is derived and investigated. By means of the step model the results obtained could be represented in the form of simple analytical formulas giving the amplitudes of the oscillations and the energy of the particles in dependence on the original conditions and the number of revolutions. It was shown that the slits do not lead to dangerous resonances. The factor ϵ/W, equal to the rate of change of relative growth of the kinetic energy at the moment of intersection of the slit of the ideal trajectory, leads to a logarithmic accumulation of the energy dispersion of the bunch. However, in the quantitative respect this effect can be distinguished from others. (tr-auth)

Storage Rings

19066 FEASIBILITY OF COLLIDING BEAM EXPERIMENTS WITH LONGITUDINALLY POLARIZED ELECTRONS. Christ, N. (Columbia Univ., New York); Farley, F. J. M.; Hereward, H. G. Nucl. Instrum. Methods; 115: No. 1, 227-231(1974).

Various methods for obtaining longitudinal polarization of electrons circulating in a high energy storage ring are analyzed. One apparently practical method is found. Such longitudinal polarization could be used to detect directly the parity violating effects of the weak interactions in proposed high energy electron-proton colliding beam machines. (auth)

19067 COMPUTER CONTROL SYSTEM USING THE HP BASIC LANGUAGE FOR THE STORAGE-RING ADONE. Matera, M.; Tazzari, S.; Vignola, G. (CNEN, Frascati, Italy). Nucl. Instrum. Methods; 115: No. 1, 89-91(1974).

The Adone storage-ring control room has been implemented with a computer facility. The system has been in operation for over one year. A short description of the control system hardware is given and some aspects of the software organization are dealt with. (auth)

19068 TWO TOPICAL QUESTIONS AT ISR ENERGY. Large Transverse Momentum Secondaries and Two-Body Correlations at Wide Angles. Jacob, M. (European Organization for Nuclear Research, Geneva). Comments Nucl. Particle Phys.; 5: No. 6, 171-179(Nov 1972).

The CERN Intersecting Storage Rings facility has yielded many interesting results that have considerably enlarged the picture of hadronic phenomena. Two questions that at present are being explored are discussed, namely, production of large transverse momentum secondaries and two-body correlations among particles produced at wide angles. In both cases the significant gain in center-of-mass energy which the ISR allows over conventional accelerators was needed in order to see clearly the specific features which distinguish the observed effects from earlier studies. Information so far obtained indicates that there are important positive short-range correlations among wide-angle pions. This suggests sizable clustering effects among secondaries not related to the fragmentation of either of the colliding protons. The effects reported, however, are too large for short-range ordering only and many of them should therefore be associated with long-range effects. (UK)

Experimental Facilities

Refer also to abstracts 18487, 18496, 18864, 18865, and 19662.

19069 (LA-tr-71-60) 14 MeV NEUTRON-PRODUCING TRITIATED TITANIUM TARGETS, FINAL REPORT. Part II. Study of the Mechanisms of Behavior and Neutron Yields. Guillaume, M.; Delfiore, G.; Weber, G.; Cuypers, M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1970. Translation of EUR-4286(Pt. 2). 60p. Dep. NTIS $5.00.

Numerous systematic attempts to prepare tritiated targets have been undertaken to find the optimum conditions for their manufacture and use under beam. It appears that the essential factor on which the properties of the tritiated target depend is thermal conductivity. The study of variation in neutron yield and half-life as functions of various factors (accelerating voltage, beam intensity, target thickness, etc.) allow the proposal of a mechanism of behavior of the tritiated target under the deuteron beam. Thicker targets (of 1500 μ-g/cm^2) are advisable for the extended duration production of high neutron beams. (auth)

19070 (RL-73-128) USERS GUIDE TO dc ELECTROSTATIC SEPARATORS AT THE RUTHERFORD LABORATORY. Eastwood, A. W. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

A guide to provide prospective users with a comprehensive document containing all the characteristics and parameters (and some of the peculiarities) of the present day dc separator is presented. It includes a compilation of extracts of assorted short papers issued by persons both at the Rutherford Laboratory and at CERN who have worked on the development of this type of separator. (auth)

19071 INITIAL RESULTS OF WORK WITH BEAMS OF SEPARATED PARTICLES ON THE IHEP ACCELERATOR. Bernard, F.; Galyaev, N. A.; Grand, A.; Zelenin, V. E.; Kotov, V. I.; Lazeras, R.; Lengeler, G.; Mareshal, B.; Prela, D.; Prilepin, A. A.; Prosin, B. V.; Khodyrev, Yu. S. At. Energ. (USSR); 35: No. 4, 227-230(Oct 1973). (In Russian).

The initial results in forming beams of separated particles on the IHEP accelerator for the Mirabelle bubble chamber from Saclay (France) are presented. The parameters of the beam of particles and high-frequency separator are given. The characteristics of the beam optical system and rf separator are given. These systems can provide the chamber with pure kaon and antiproton beams in the momentum interval 17 to 40 GeV/c and pion beams with momenta up to 50 GeV/c. Preliminary analysis of the pictures obtained in the kaon beam with p = 32 and 34 GeV/c, has exhibited the fact that impurity of other particles in the beam is not more than 2%. (auth)

19072 SYNCHROCYCLOTRON AND ITS PROTON BEAM. Whitehead, C. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Roy. Soc. Med.; 67: No. 1, 29-31(Jan 1974).

Some physical properties of proton beams are described and their applicability to therapy discussed. The similarity of the proton beams available from the Harwell and Harvard Synchrocyclotrons is stressed, and some details are given of a proposal made to the Medical Research Council to use the 160 MeV Harwell synchrocyclotron for proton therapy by emulating the work of the Massachusetts General Hospital and Harvard University. Note is also taken of the use of proton beam therapy for treatment as carried out at Harvard, Berkeley, Uppsala and Dubna. (auth)

19073 VARIANTS OF THE BEAM LAYOUT FOR THE FIAN LINEAR ELECTRON ACCELERATOR. Dzhilavyan, L. Z.; Oboznyi, V. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 69: 125-128(1973). (In Russian).

The possibilities of variants of the beam layout are examined with consideration of the geometry of the experimental hall, the presence of electron-optical elements, and the proposed physical experiments at the FIAN linear electron accelerator. The characteristics of the calculated beam transport system are given. A comparison is made of the variants of the beam layout. (tr-auth)

19074 CARRIER-LOADED HELIUM-JET TRANSPORT METHOD. Aeystoe, J.; Puumalainen, P.; Valli, K. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 115: No. 1, 65-73(1974).

The suitability of commercial helium loaded with small amounts of different gases or vapors for the transport of radioactive reaction products over distances of several meters has been investigated experimentally. Negative results were obtained with gaseous carriers. Transport efficiencies of 50 to 100% were obtained with carrier vapors. The vapor appears to form droplets in the system. The recoils are adsorbed physically by the droplets and carried with them through a capillary. There appears to be an active mechanism that forces the heavy constituents to the center of the capillary cross section. The heavy constituents emerge from the capillary as a very narrow beam. Collection of the transported activity onto a metal foil in a vacuum chamber is possible only when the vapor pressure of the carrier is lower than the pressure of the collection chamber. Vacuum pump oil was found to meet this requirement. The transport and collection efficiency was studied as a function of the relative mass through-put of the oil vapor. A method for determining the optimum mass throughput of the carrier is demonstrated. The internal energetics of the system are discussed. The kinetic energy of a particle to be transported has to be higher than the average thermal energy in order to avoid adsorption onto the capillary walls. This can be achieved by increasing the mass of the particle by means of a carrier or by decreasing the system temperature. In a cooled system transport over long distances is possible even with pure helium. Application of the carrier-loaded transport method in on-line mass separators is discussed. (auth)

19075 COMPUTER CONTROL OF A POLARIZED TARGET NMR SYSTEM. Johnsen, S. W. (Univ. of California, Davis). Nucl. Instrum. Methods; 115: No. 1, 309-310(1974).

A computerized n.m.r. system for a polarized proton target is described. The computer programs the frequency sweep, tuning, data collection, and performs on-line analysis of the n.m.r. signal. (auth)

19076 USE OF SUPERCONDUCTING MAGNETS IN PARTICLE BEAMS AT 400 GeV. Kircher, F.; N'Guyen Sieu Viet; Parain, J. (CEN, Saclay, France). Nucl. Instrum. Methods; 115: No. 1, 213-220(1974). (In French).

The possibility of using superconducting magnets on primary and secondary beams is studied both physically and economically. After a description of the magnets (dipoles and quadrupoles) and of the evaluation of their cost, their advantages to shorten beam transports and to reduce their costs are shown. Some special applications on secondary beams, where superconducting magnets are necessary to reduce length, or increase acceptance or resolution, are described. (auth)

19077 DESIGN AND OPERATION OF THE YALE–NAL–BNL HYPERON BEAM. Hungerbuehler, V. (Yale Univ., New Haven); Kraybill, H.; Majka, R.; Marx, J. N.; Nemethy, P.; Sandweiss, J.; Tanenbaum, W.; Willis, W. J.; Winters, L. J.; Atac, M.; Ecklund, S.; Gollon, P. J.; Lach, J.; MacLachlan, J.; Roberts, A.; Stefanski, R.; Theriot, D.; Wang, C. L. Nucl. Instrum. Methods; 115: No. 1, 221-225(1974).

The design and operation of a negative hyperon beam at the Brookhaven AGS is described. Fluxes of 200 Σ^- and 2 Ξ^- per 1.5×10^{11} interacting protons are delivered to a double magnetic spectrometer where decay products are analyzed. Hyperons are identified by kinematic fitting of their decays. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 18030, 18497, 18498, and 19556.

19078 CHEMICAL CLASSIFICATION OF IRON METEORITES. VII. A Reinvestigation of Irons With Ge Concentrations Between 25 and 80 ppM. Scott, E. R. D. (Univ. of California, Los Angeles); Wasson, J. T.; Buchwald, V. F. Geochim. Cosmochim. Acta; 37: 1957-1983(Aug 1973).

19079 INTENSITY MEASUREMENTS OF LOW ENERGY COSMIC RAY MUONS UNDERGROUND. Bhat, P. N.; Murthy, P. V. R. (Tata Inst. of Fundamental Research, Bombay). J. Phys., A (London); 6: No. 12, 1960-1973(Dec 1973).

Intensities of cosmic-ray muons coming to rest in a 444 liter liquid scintillator tank at depths 96, 417, and 985 hg cm^{-2} (1 hg cm^{-2} = 100 g cm^{-2} of matter underground) have been measured to be $(7.67 \pm 0.4) \times 10^{-6}$, $(7.9 \pm 0.5) \times 10^{-4}$, and $(6.9 \pm 0.7) \times 10^{-3}$ muons $cm^{-2}s^{-1}sr^{-1}$ (100 g cm^{-2} of rock)$^{-1}$ respectively. Experimental details are given and the results discussed. It is concluded that the observations can be accounted for in terms of two components: (i) muons produced in the atmosphere and penetrating to the respective depths; and (ii) muons generated locally by the decays of pions which are in turn produced in the hadronic cascades initiated by high-energy muons via photomeson production by the virtual and real photons associated with muons. No new process for low-energy muon production is required at the depths investigated. (auth)

19080 ELECTRONIC SHOWERS OF COSMIC-RAY PARTICLES AT HIGH ALTITUDE. Ting, L. K.; Li, T. P.; Shen, C. C.; Ts'ai, P. C. Wu-li; 2: No. 3, 115-121(Aug 1973).

At 3200 m above sea level, a lead-plate cloud chamber having an effective volume of 45 × 45 × 14 cc was used to measure the probability of electromagnetic showers of cosmic-ray particles. The region of energy transfer was 0.4 to 2 GeV. A total of 801 useful events was obtained. The average probability of electromagnetic showers, in 1.25 cm thick lead, of cosmic-ray particles at high altitude was $[4.62 \pm 0.76] \times 10^{-3}$. This is greater than that predicted by theory or derived from accelerator experiments for μ, ρ, $\pi^{\pm}$ particles. A statistical analysis of the experimental results is presented. (JPRS)

19081 POSSIBILITIES AND LIMITATIONS OF NEUTRON MULTIPLICITY MEASUREMENTS. Vinje, J. A. (Univ., Amsterdam). Planet. Space Sci.; 22: No. 1, 177-179(Jan 1974).

An analysis of the errors in multiplicity measurements in neutron monitors shows that the errors introduced by correcting for gating time, dead time, and discriminator dead time are of such a magnitude that one should not apply such corrections. Further it is shown that the errors in uncorrected data are much smaller than usually is assumed. (auth)

19082 COMPOSITION OF LOW-ENERGY COSMIC RADIATION FROM SILICON TO NICKEL. Soederstroem, K.; Lindstam, S.; Behrnetz, S.; Kristiansson, K. (Univ. of Lund, Sweden). Astrophys. Space Sci.; 21: No. 1, 211-222(Mar 1973).

The charge composition of the cosmic radiation for the elements with $Z \geq 14$ was studied in a stack of nuclear emulsions exposed at Fort Churchill in July 1967. Particles stopping in the stack were measured with a nuclear track photometer to determine the charge. Relative abundances are given for the elements silicon to nickel, and comparison is made with other investigations. (3 figures, 5 tables) (auth)

19083 EFFECTS OF LARGE EXTENSIVE AIR SHOWERS ON THE EARTH'S ATMOSPHERIC ELECTRIC FIELD. Curry, A.; Kannangara, M. L. T.; Turver, K. E. (Univ. of Durham, Eng.). J. Atmos. Terrest. Phys.; 36: No. 2, 215-224(Feb 1974).

Data have been obtained which suggest that changes in the Earth's electric field of 10 to 20 V m^{-1} occur close to the cores of extensive air showers initiated by primary particles of energy $\gtrsim 10^{17}$ eV. Such changes are detectable using simple equipment in fair weather conditions. (auth)

19084 ADIABATIC DECELERATION OF COSMIC RAYS NEAR THEIR SOURCES. Wentzel, D. G. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 23: No. 2, 417-424(Aug 1973).

Every plausible source of cosmic rays yields a high flux of cosmic rays near the source. The high flux leads to plasma effects that cause scattering of the cosmic rays, coupling to the interstellar gas and hence to adiabatic deceleration. The cosmic rays are released from the gas only when their pressure has fallen to the cosmic-ray pressure near the Sun multiplied by a factor between 10 and 100. A model aimed to minimize the deceleration before the cosmic rays are released is discussed. The volume which cosmic rays occupy before scattering is maximized by injection into a large but thin disk. Even then, deceleration is reduced only to a factor of two. Such deceleration should cause quasi-supernova remnants somewhat resembling the Cygnus loop but associated with much younger pulsars. Since both the required model and the predicted observations cause difficulties, the problem of adiabatic deceleration remains severe. (auth)

19085 SOLAR MODULATION OF COSMIC-RAY ALBEDO NEUTRONS. Hedili, S. O. (Univ. of New Hampshire, Durham). Astrophys. Lett.; 15: No. 2, 49-54(Oct 1973).

An experiment was performed with a neutron detector on the OGO-VI satellite to determine the solar modulation of the cosmic-ray albedo neutrons. The solar cycle modulation of the albedo neutron flux (≤ 10 MeV) was found to be similar to the 11-yr variation of the integral flux of galactic cosmic-ray protons at similar geomagnetic cutoff rigidities. At low cutoff rigidities (≤ 0.6 GV) the results indicated a high depression of the low-energy particles during the period 1969 June 7–December 23. The measured 11-yr modulation of the cosmic-ray albedo neutrons (≤ 10 MeV) was in good agreement with the calculations of Lingenfelter. The cosmic-ray albedo neutron flux (≤ 10 MeV) and the integral flux of galactic cosmic-ray protons at similar geomagnetic cutoff rigidities were similarly depressed during Forbush decreases. (auth)

19086 ROLE OF PLASMA EFFECTS IN THE COSMIC-RAY PROPAGATION AND ISOTROPIZATION IN THE GALAXY. Ginzburg, V. L.; Ptuskin, V. S.; Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow). Astrophys. Space Sci.; 21: No. 1, 13-38(Mar 1973).

Cosmic ray (c.r.) propagation in interstellar magnetic fields is often considered in the diffusion approximation, i.e. by the diffusion equation in the coordinate space. The cosmic ray momentum distribution in this case is considered isotropic when the space gradients of c.r. density are absent. This approach, with the use of an unfixed effective diffusion coefficient, D, independent of the energy, E, enables one to describe all the data available. However, neither the diffusion mechanism nor the limits of applicability of the diffusion approximation are clear, particularly if D is independent of E. Furthermore, the diffusion coefficient, D, must be expressed through the characteristics of the interstellar medium and possibly through the flux velocity and density of c.r., etc. One of the possible approaches for the analysis of the mechanism and characteristic features of c.r. distribution and isotropization is the account taken of the plasma effects and, specifically, the study of c.r. flux instability arising when c.r. are moving in the interstellar plasma. As a result of such instability c.r. may generate waves of different types (magneto-hydrodynamic, high-frequency plasma, and other waves). Generation of waves and scattering on them result in isotropization of cosmic rays, while their propagation under certain conditions turns out similar to that under diffusion. An attempt is made to analyze systematically the above-mentioned plasma effects and to find out to what extent they are responsible for the behavior of c.r. in the Galaxy. It turns out that c.r. isotropization in the interstellar medium itself due to their wave generation is not a decisive factor. In any case this is true if this mechanism is regarded as the only c.r. isotropization mechanism within a wide energy range from 1 to 1000 GeV. Isotropization and spatial diffusion of c.r. up to E ~ 100 to 1000 GeV on the waves from external sources (for example, on the waves from the supernova shells) also proved impossible if the diffusion coefficient is assumed to be independent of c.r. energy. Some new possibilities of c.r. isotropization are also considered. (1 figure) (auth)

19087 RELATIVE ABUNDANCE OF THE ISOTOPES OF Li, Be, AND B AND THE AGE OF COSMIC RAYS. Webber, W. R.; Lezniak, J. A.; Kish, J.; Damle, S. V. (Univ. of New Hampshire, Durham). Astrophys. Space Sci.; 24: No. 1, 17-29(Sep 1973).

Using a balloon borne-double dE/dx x total energy telescope the isotopic composition of cosmic ray Li, Be, and B nuclei in the energy range 100–250 MeV/N was determined. The measured mass resolution σ for these nuclei was ~0.3 AMU. The observed isotopic composition was in agreement with that predicted on the basis of interstellar fragmentation with the exception of a defi-

ciency of ^{10}Be. If the low abundance of ^{10}Be is attributed to the decay of this radioactive isotope a mean cosmic-ray lifetime of $(3.4^{+2}_{-3}) \times 10^6$ yr is obtained. (auth)

19088 NATURE OF COSMIC-RAY SOURCES. Lingenfelter, R. E. (Univ. of California, Los Angeles). Astrophys. Space Sci.; 24: No. 1, 83-94(Sep 1973).

The limitations on the nature of cosmic-ray acceleration regions and processes, as deduced from cosmic-ray measurements and propagation studies, are reviewed. The power requirements for these acceleration regions are estimated from measurements of the local cosmic-ray energy density, anisotropy, and spallation-deduced pathlength. Possible constraints on the acceleration spectrum of the cosmic rays and on a charge dependence of the acceleration process, implied by the measured cosmic-ray spectrum and composition, are considered. Various suggested sources and processes of cosmic-ray acceleration are discussed in the light of these limitations. (auth)

19089 SEARCH FOR CORRELATIONS IN THE ARRIVAL TIMES OF EXTENSIVE AIR SHOWERS AND WEBER GRAVITATIONAL WAVES. Kanofsky, A. (Lehigh Univ., Bethlehem, PA); Tutin, M.; Kanofsky, P. Lett. Nuovo Cim.; 9: No. 4, 127-133 (26 Jan 1974).

In an experimental search for correlations in the arrival times of extensive air showers and Weber gravitational waves the only evidence for correlations was found in the occurrence of double pairs of coincidences. The probability of observing such pairs in this experiment for random uncorrelated arrival times was calculated to be less than 1%. (LBS)

19090 DIFFUSE COSMIC X-RAY BACKGROUND SPECTRUM IN THE 2 TO 10 keV ENERGY RANGE. Adams, D. J. (Univ. of Leicester, Eng.); Ricketts, M. J. Astrophys. Space Sci.; 24: No. 2, 585-592(Oct 1973).

A measurement is reported of the background spectrum based on 10,000 counts observed in the energy range 2 to 10 keV. The rocketborne detector system was optimized for cosmic-ray noise rejection. A best fit power law spectrum $dN/dE = 16\ E^{-1.8}$ photons $cm^{-2}\ s^{-1}\ keV^{-1}$ resulted from the analysis. At 10 keV this result is consistent with recently assessed higher energy data. It is shown therefore that the change in spectral index between 5 and 50 keV is approximately −0.2. (auth)

19091 EXTRAGALACTIC COSMIC RAYS AND THE GALACTIC MAGNETIC FIELD. Parker, E. N. (Univ. of Chicago). Astrophys. Space Sci.; 24: No. 1, 279-288(Sep 1973).

The origin and behavior of cosmic rays in the Galaxy depends crucially upon whether the galactic magnetic field has a closed topology, as does the field of Earth, or whether a major fraction of the lines of force connect into extragalactic space. If the latter, then cosmic rays could be of extragalactic origin, or they could be of galactic origin, detained in the Galaxy by the scattering offered by hydromagnetic waves, etc. If, on the other hand, the field is largely closed, then cosmic rays cannot be of extragalactic origin (at least below 10^{16} eV). They must be of galactic origin and escape because their collective pressure inflates the galactic field and they push their way out. This paper examines the structure of a galactic field that opens initially into intergalactic space and, with the inclusion of turbulent diffusion, finds no possibility for maintaining a significant magnetic connection with an extragalactic field. Unless some mechanism can be found, one is forced to the conclusion that the field is closed, that cosmic rays are of galactic origin, and that cosmic rays escape from the Galaxy only by pushing their way out. (auth)

19092 COMPARATIVE STUDY OF ^{26}Al AND ^{53}Mn IN EIGHTEEN CHONDRITES. Heimann, M.; Parekh, P. P.; Herr, W. (Univ., Cologne). Geochim. Cosmochim. Acta; 38: No. 2, 217-234(Feb 1974).

An investigation on the low-energy cosmic-ray products ^{26}Al and ^{53}Mn in 18 chondrites encompassed several side aspects in meteoritics. The ratio of observed to calculated specific activity of ^{26}Al in 13 chondrites with recovered masses ranging from ~3 to 2000 kg remains constant within ±15 per cent of a mean of 0.93. This is consistent with Fuse and Anders' observation (Geochim. Cosmochim. Acta; 33:653 to 670 (1969)) of invariance of the ^{26}Al-production rate with depth and size. A plot of the ^{53}Mn specific production rate (dpm/kg Fe) versus recovered meteorite mass revealed that the compensation by the secondaries for the absorption of the primaries is also effective in the case of ^{53}Mn. Thus, the ^{53}Mn production rate remains rather constant within ±15 per cent of a mean of 520 dpm/kg Fe for most of the stones. Applying this information to two chondrites, Ladder Creek and Scurry, of known relatively short exposure and terrestrial ages, the ^{53}Mn half-life (T_{53}), computed from their $^{53}Mn_{obs}/^{26}Al_{obs}$ ratios, is found to be 3.85 ± 0.4 m.y. which agrees very well with the currently accepted value of $T_{53} = 3.8 \pm 0.6$ m.y. From the observed ^{53}Mn/^{54}Mn activity ratio in Allende, relative to the production rate ratio of 0.98, an exposure age of $t_R = 4.2$ m.y. is derived, in concordance with literature data. The result strongly suggests that this isotope pair holds promise as an index of absolute radiation ages of fresh falls. (auth)

19093 RADIONUCLIDES PRODUCED BY COSMIC RADIATION IN THE SAINT-SEVERIN METEORITE. Bibron, R.; Leger, C.; Tobailem, J.; Yokoyama, Y.; Mabushi, H.; Baillard N. (CEN de Saclay, Gif-sur-Yvette, France). Geochim. Cosmochim. Acta; 38: No. 2, 197-205(Feb 1974).

The activities of 18 radionuclides in 4 samples from the Saint-Severin meteorite have been measured after chemical separation. The results show that the DI sample from the D piece has been less irradiated than the samples B_2, B_3, and B_4 from the B piece. This is based on activities of isotopes produced both by spallation as ^{26}Al, ^{53}Mn, ^{54}Mn, ^{55}Fe, ^{57}Co and by thermal neutron capture as ^{59}Ni and ^{60}Co. Comparison of experimental values with calculated production rates suggests that the D piece was connected to the main body of the meteorite by a small surface, and that the DI sample in this piece was opposite to the main body of the meteorite. (auth)

19094 SPECTRA OF RADIOACTIVITY INDUCED IN CESIUM IODIDE SCINTILLATOR CRYSTALS BY 155 MeV PROTONS. Carpenter, G.; Dyer, C. S. (Imperial Coll. of Science and Tech., London). Astrophys. Space Sci.; 24: No. 1, 95-104(Sep 1973).

Previous work has shown the importance of induced radioactivity as a source of background counts in x- and γ-ray astronomy experiments which use scintillation detectors. Comprehensive data on the decay spectra observed in cesium iodide crystals following irradiation by 155 MeV protons has been obtained by the Imperial College group and is presented here. The spectra cover the energy loss range from 20 keV to 3.4 MeV and were collected at times after irradiation ranging from 1 min until 200 d. A sufficient selection of spectra is given to enable calculations to be made of the time variations in radioactivity which would be observed in similar space-borne detectors subjected to irradiation by inner belt and cosmic-ray protons. Examples of such calculations are given. (auth)

19095 HYPOTHESIS OF DUST GRAIN ORIGIN OF COSMIC-RAY AIR SHOWERS (RESEARCH NOTE). Berezinskii, V. S.; Prilutskii, O. F. (Lebedev Inst. of Physics, Moscow). Astrophys. Space Sci.; 21: No. 2, 475-476(Apr 1973).

It is shown that relativistic and subrelativistic dust grains accumulate large electric charges as a result of the interaction with photons and interstellar gas atoms. The developing electrostatic forces break up the grains. The relativistic dust grains break effectively within the solar system and, therefore, cannot give rise to the observed extensive air showers. (JFP)

Stars

Refer also to abstracts 19212, 19309, 19625, 19801, and 19836.

19096 EXTENDED ATMOSPHERES AND CIRCUMSTELLAR MATTER IN SPECTROSCOPIC BINARY SYSTEMS. International Astronomical Union Symposium No. 51 Held at Parksville, British Columbia, September 6–12, 1972. Batten, A. H. (ed.). Boston; D. Reidel Publishing Company (1973). 302p. (CONF-7209105-). $32.00.

The main topics covered included: observations of the flow of matter within binary systems; problems of gaseous motion around stars; expanding envelopes of stars; observations of stellar spectra related to extended atmospheres; theory of extended and expanding atmospheres; and evolutionary aspects of circumstellar matter in binary systems. (WDM)

19097 FORBIDDEN LINES OF NEUTRAL CARBON IN NGC 7027. Danziger, I. J.; Goad, L. E. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. Lett.; 14: No. 2, 115-117(Jun 1973).

The identification in NGC 7027 of forbidden emission lines of neutral carbon at 9849.5, 9823.4, and 8727.4 Å is reported. Some implications of their strengths, under the assumption that the metastable levels are populated by electron collisions, are discussed. (auth)

19098 NEUTRON STAR MOMENTS OF INERTIA: THEORETICAL IMPLICATIONS OF THE OBSERVATIONAL DATA. Carter, B.; Quintana, H. (Inst. of Astronomy, Cambridge, Eng.). Astrophys. Lett.; 14: No. 2, 105-109(Jun 1973).

The moment of inertia of a neutron star is shown to depend very sensitively on the form of the equation of state for neutron star matter—much more so than the mass. Consequently it is

possible to use existing observational data, derived mainly from the Crab Nebula pulsar, to rule out some of the "softer" theoretical equations of state that have been proposed for neutron star matter. This provides indirect evidence for the form of the short-range repulsive forces between nucleons. (auth)

19099 SOUTHERN INFRA-RED STANDARDS AND THE ABSOLUTE CALIBRATION OF INFRA-RED PHOTOMETRY. Thomas, J. A.; Hyland, A. R.; Robinson, G. (Univ. of Melbourne). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 201-211(1973).

Infrared photometric measurements of a set of bright southern stars are presented. Flux comparisons are made relative to γ Crucis between 1.25 μ and 11.2 μ, and recent solar data are used to establish the actual flux values, using α CenA as a transfer star. A model of a single star (α Lyr) is used to establish an absolute calibration, and solar colors, transferred via α CenA (with the assumption that the red and infrared spectral energy distribution of α CenA is identical to that of the Sun) provide a new magnitude scale. The 4.8-μ flux in late K and M stars appears to be significantly depressed. A major contributor to this depression is probably absorption by the fundamental vibration rotation bands of CO. (auth)

19100 CONVECTION IN ROTATING STARS. Tayler, R. J. (Sussex Univ., Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 39-52(1973).

The influence of rotation on convection in stellar interiors is discussed. It is shown that the character of convective motions can be affected in relatively slowly rotating stars. Although the transport of energy by convection is anisotropic, the requirement that the divergence of total energy flux vanishes means that meridional circulation currents will be set up. These will mix the material of a convective core in a time which is not much different from the time taken by convection in the absence of rotation. Although rotation does not seriously impede mixing processes in a convective core, the circulation transports angular momentum and changes the law of rotation of the star. The final state of rotation cannot be determined until the form of convection in a rotating star is better understood, but it is possible that the asymptotic state is closer to one of uniform angular momentum than uniform angular velocity. (auth)

19101 PULSATIONAL INSTABILITY OF ISOTHERMAL GAS SPHERES WITHIN THE FRAMEWORK OF GENERAL RELATIVITY. Yabushita, S. (Kyoto Univ.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 17-24(1973).

Investigation is made of the general relativistic pulsational instability of gaseous spheres such that the equation of state is of the form $p = q\rho$, where p and ρ are the pressure and energy-density, respectively, and q is a constant. Assuming that during pulsation the motion takes place adiabatically with index γ, the equation for spherical pulsation is derived by using general relativity. It is shown that the spheres, if sufficiently compressed, are unstable. The degree of compression needed to make the spheres unstable depends on the two parameters, γ and q. For a given value of q, the degree of compression needed increases with γ, while for given γ, the compression needed decreases with increasing q. When q approaches zero, the equation of pulsation reduces to the corresponding equation in Newtonian theory for isothermal gas spheres. Post-Newtonian effects are also briefly discussed. (auth)

19102 ABSOLUTE MAGNITUDES OF B-TYPE PRIMARIES IN VISUAL BINARIES. Andrews, P. J.; Thackeray, A. D. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 1-9(1973).

UBV photoelectric photometry data are given for 12 faint secondary components of physical pairs with early-type primaries, most of which are accepted as members of the Sco–Cen association, and from the data the luminosities of the primaries are determined. (UK)

19103 DUST TEMPERATURES AROUND HOT STARS. Allen, D. A.; Penston, M. V. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 121-131(1973).

Infrared and spectroscopic observations of hot stars in clusters, groups, and the field are interpreted. Their circumstellar dust shells are found to have greater inner radii for the hotter stars, so that the stellar and dust temperatures are anti-correlated. There is also evidence that the hotter forbidden-line stars have thicker dust shells. The time scale for dispersion of dust by radiation pressure or stellar winds precludes the dust being primeval. The best explanations for the observed correlations invoke the formation of dust in density inhomogeneities and its destruction by sputtering or ultraviolet radiation. However, around all the stars in the sample examined the zones of grain growth must have had similar density. (auth)

19104 EVOLUTIONARY CONSIDERATIONS INVOLVING THE INTERNAL DENSITY CONCENTRATION PARAMETER OF BINARY STARS. Petty, A. F. (Univ. of Pennsylvania, Philadelphia). Astrophys. Space Sci.; 21: No. 1, 189-209(Mar 1973).

The evolutionary changes that occur in the internal density concentration parameter k_2 (called the apsidal constant for brevity) for a star of given mass and initial composition are examined in detail. The purpose is to ascertain whether or not such an approach leads to a reduction in the differences now noted between the theoretically derived values of k_2 and the observed values derived from the secular advance of the periastron in close eclipsing binary systems. A series of stellar models of mass 2.0, 5.0, 10.0, and 20.0 M were employed, with an initial compositional mixture of X = 0.739, Y = 0.24, and Z = 0.021. These models cover an evolutionary range from a point in time where the star has just completed the Hayashi phase of its pre-Main Sequence contraction through its entire Main Sequence phase to the point where hydrogen depletion in the core is complete. For each model, a value of k_2 is determined by numerically integrating Radau's equation and using the values of $\rho(a)/\bar{\rho}$, the ratio of the star's density at point a to its mean density, as taken from the models. The result is the time history of k_2 for each stellar mass over the evolutionary range of interest. The results are then summarized in the ($\log k_2$, $\log T_e$) plane which, for the first time, quantitatively indicates the variation in k_2 as a function of the evolutionary state of the star. A comparison between these theoretically derived values of k_2 and a selected set of observationally determined ones immediately indicates that the secular variation in k_2 plays an extremely important part in any comparison between theory and observation. For most of the cases studied, the difference between the theoretically and observationally determined values of k_2 can be reconciled in terms of the evolutionary history of the binary system. While tentatively providing a satisfactory explanation for the previously noted differences in the determination of k_2, there now exists the problem of accurately pinpointing the evolutionary state of the observed binary system. (auth)

19105 STELLAR CN BAND STRENGTHS AND THE ABUNDANCE OF NITROGEN. Harmer, D. L.; Pagel, B. E. J. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 91-120(1973).

Violet and ultraviolet CN band strength parameters observed photoelectrically and photographically, respectively, are related by a semi-empirical method to horizontal curve-of-growth shifts predicted from model atmospheres with known basic parameters θ_{eff}, g, and [Fe/H], assuming that [C/Fe] = [O/Fe] = [N/Fe] = 0. Population I stars generally are found to fit the standard relations, implying little variation in the abundances of C, N, O and relative to metals, except in certain special cases in which either such variations occur or the basic parameters are in doubt (e.g. μ Leo, And). Stars with halo kinematics, on the other hand, quite often have weaker CN bands than predicted, most probably because [N/Fe] < 0, although HD 25329 and a CN star deviate in the opposite direction. Most of the halo stars may fit the relation [N/Fe] ≈ [Fe/H], which is not unexpected on the basis of current ideas on explosive nucleosynthesis, but the weakness of their CN bands leads to ambiguous results except in a few cases. (auth)

19106 INFRA-RED PHOTOMETRY OF RR TELESCOPII AND OTHER EMISSION-LINE OBJECTS. Glass, I. S.; Webster, B. L. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 77-89(1973).

Infrared measurements at three or more wavelengths between 1.25 and 20 microns are described for 16 emission-line objects in the later stages of their evolution. In the slow nova RR Tel the infrared energy distribution resembles that from free–free and free–bound processes, but is two orders of magnitude stronger than expected from the visible spectrum. A cool stellar component was detected for the first time in three objects and confirmed in eight known symbiotic stars. Radiation from dust is found to be characteristic of a small subclass of symbiotic stars and of two unusual planetary nebulae. (auth)

19107 CORRELATIONS AMONG THE PARAMETERS OF THE SPHERICAL MODEL FOR ECLIPSING BINARIES. Sobieski, S.; White, J. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Space Sci.; 21: No. 1, 7-12(Mar 1973).

Correlation coefficients were computed to investigate the parameters used to describe the spherical model of an eclipsing binary system. Regions in parameter hyperspace were identified where strong correlations exist and, by implication, the solution determinacy is low. The results are presented in tabular form for a large number of system configurations. (5 tables) (auth)

19108 NONCOHERENT SCATTERING IN TRANSFER PROBLEMS IN SPHERICAL SHELL MEDIA. I. Frequency-Independent

Source Function. Kho, T. H.; Sen, K. K. (Univ. of Singapore). Astrophys. Space Sci.; 21: No. 1, 39-57(Mar 1973).

The Combined Operations Method is utilized to solve diffuse reflection and transmission problems in inhomogeneous, isotropically and noncoherently scattering, spherical shell media. The source function is assumed to be frequency independent. The N solution of an auxiliary equation is sought, and tractable equations for the scattering and transmission functions are established. The solution of the problem for a scattering and emitting medium was considered for a perfectly absorbing core. (1 figure) (auth)

19109 PROBABILISTIC MODEL FOR RADIATIVE TRANSFER PROBLEMS IN CYLINDRICAL SHELL MEDIA WITH COMPLETE REDISTRIBUTION IN FREQUENCY. Leong, T. K.; Sen, K. K. (Univ. of Singapore). Astrophys. Space Sci.; 21: No. 1, 59-72(Mar 1973).

A probabilistic model for solving transfer problems in nonhomogeneous, isotropic, and noncoherent scattering cylindrical shell media is proposed. The source function is considered to be frequency independent. The scattering and transmission functions are defined for the case of complete redistribution in frequency. A tractable integrodifferential equation for the scattering function is derived. (1 figure) (auth)

19110 RELATIONS BETWEEN THEORETICAL AND OBSERVED COLORS IN THE BVRI SYSTEM. Caputo, F.; Natta, A. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astrophys. Space Sci.; 21: No. 1, 73-77(Mar 1973).

Transformation relations from theoretical apparent magnitude and (b−v), (v−r), (v−i) colors to the observed m_v and (B−V), (V−R), (V−I) quantities are derived. Black-body colors in the BVRI system are also computed. (4 figures, 1 table) (auth)

19111 NEUTRON STAR MATTER. Phase Transition to a Neutron Solid. Oestgaard, E. (Univ. of Trondeheim, Norway). Phys. Lett.; 47B: No. 4, 303-305(26 Nov 1973).

The ground-state energy and pressure of a neutron solid was calculated by means of a modified Brueckner theory. The possibility of a phase transition from normal neutron matter into a neutron solid was then considered, but no phase transition was found to occur for the specific two-body potential assumed. (auth)

19112 PHOTOMETRIC STUDY OF NEW VARIABLE STARS IN NGC 2264. Badalyan, G. S.; Erastova, L. K. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 21-27(1972). (In Russian).

19113 CURVATURE EFFECTS IN EXTENDED STELLAR ATMOSPHERES: PURE ABSORPTION. Peraiah, A. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 21: No. 1, 223-235(Mar 1973).

The effects of curvature in an atmosphere with pure absorption are investigated. Numerical solution of the transfer equation was obtained in the framework of the Discrete Space Theory of Radiative Transfer. Two cases were considered: the atmosphere is irradiated at the bottom and there is no incident radiation at the top of the atmosphere; no radiation is incident on either side of the atmosphere. It was found that the thermal sources inside the atmosphere dominantly influence the emergent radiation, and this is very much so in the spherical case and for large optical thickness. The emergent luminosities increase with the geometrical thickness, although the emergent specific intensities are reduced; the former seems to be because of the larger surface area, and the latter seems to be because of the effects of curvature. (8 figures) (auth)

19114 NONCOHERENT SCATTERING IN TRANSFER PROBLEMS IN SPHERICAL SHELL MEDIA. II Frequency-Dependent Source Function. Kho, T. H.; Sen, K. K. (Univ. of Singapore). Astrophys. Space Sci.; 21: No. 1, 237-255(Mar 1973).

The Combined Operations Method was used to solve the diffuse radiation problems in inhomogeneous, noncoherently scattering, spherical shell media. A redistribution function was introduced so as to account for the frequency-dependent source function. The relevant auxiliary equation was formulated; and its N solution, sought. A scattering and emitting medium with a partially transparent core was considered. (auth)

19115 POLARIZATION VARIATIONS IN THE EMISSION OF SOME M-TYPE SUPERGIANTS. Arsenevich, E. D. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 91-103(1972). (In Russian).

Emission polarization was observed in mu-Cep, VV Cep, RW Cep, ST Cep, RW Cyg, and TZ Cas from June through October, 1969, on 16 and 20-in. telescopes at the Biurakan Observatory. It was found that the polarization in light from these stars is of an intrinsic nature with a minimum in the yellow spectral region. (IAA)

19116 SOME FEATURES OF THE INFRARED SPECTRUM OF NGC7027 AND AN ESTIMATE OF ITS SULPHUR ABUNDANCE. Aitken, D. K.; Jones, B. (University Coll., London). 165: No. 4, 363-368(1973).

Observations of NGC 7027 in the range 10 to 12 μ are presented, with a spectral resolution of $\Delta\lambda/\lambda = 0.005$. The S IV line at 10.5 μ is clearly seen, and also the feature at 11.3 μ which has been observed by Gillet, Forrest, and Merrill (Astrophys. J.; July (1973)) and which may be due to thermal emission from $MgCO_3$ grains. A previously unobserved sharp feature is seen at 11.9 μ. A sulphur abundance between 6.86 and 7.12 (relative to H = 12.00) is deduced from the intensity of the S IV line, and the possibility that the 11.3 and/or the 11.9 μ features are due to unresolved clusters of lines is briefly discussed. (auth)

19117 ABSOLUTE MAGNITUDES OF SEMI-REGULAR VARIABLES IN THE SOLAR VICINITY FROM STATISTICAL PARALLAXES. Aslan, Z. (Ankara Univ.). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 337-354(1973).

Absolute magnitudes of semi-regular and RV τ variables have been determined from radial velocities and proper motions. (1) Photographic absolute magnitudes of M-type SRab variables vary with spectral type from $0^m.0$ at about M4 to $+2^m.5$ at M6 at mean brightness. (2) Absolute magnitude of M-type SRa and b variables without emission is a function of period. M_{pg} at mean and maximum brightness may be expressed as M_{pg} (mean) = 0.6 + 3.9 (log p − 2.0) and M_{pg} (max) = 0.1 + 2.8 (log p − 2.0), where p is the period in days. These variables are fainter than the Miras at a given period. (3) SRab variables with $p \leq 200$ days showing emission lines fall on the extension of the period–absolute magnitude relation for Mira variables. There is no significant difference between SRab M and SRab Me variables for $p > 200$ days. (4) The mean absolute magnitude of N-type semi-regular variables has also been determined from differential galactic rotation. The combined mean value is $M_{pg}(max) = +0^m.7 \pm 0^m.4$. (5) ERd variables have $M_{pg}(mean) = -0^m.9 \pm 0^m.4$ and $M_{pg}(max) = -1^m.7 \pm 0^m.4$. (6) RV τ variables have $M_{pg}(mean) = -0^m.5 \pm 0^m.6$ and $M_{pg}(max) = -1^m.7 \pm 0^m.6$. The present results have been compared briefly with the absolute magnitudes of similar stars in clusters. (auth)

19118 SEA SEDIMENTS, COSMIC RAYS, AND PULSARS. Higdon, J. C.; Lingenfelter, R. E. (Univ. of California, Los Angeles). Nature (London); 246: No. 5433, 403-405(14 Dec 1973).

It is suggested that measured variations of ^{10}Be and ^{26}Al in deep sea sediments may result from increases in the local cosmic-ray intensities produced by a nearby supernova explosion. (auth)

19119 SPECTROSCOPIC SURVEY OF SOUTHERN HEMISPHERE WHITE DWARFS. 3. Binaries Containing a White Dwarf. Wegner, G. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 271-294(1973).

Both components of five proper motion binaries containing a white dwarf were studied spectroscopically. A coarse differential analysis was carried out on the bright, nondegenerate components and gravitational redshifts were measured for the white dwarfs. From the present ages of the binaries as determined from theoretical isochrones, it was concluded that all of the white dwarfs in the present study formed from stars that underwent mass loss. From the present masses of the white dwarfs, up to about one solar mass could have been lost during the formation of a white dwarf. The star HR 2274 which has a DB star as a companion seems to be slightly metal enriched and deficient in a s-process elements, while HR 6094 and HR 5864 have strong H and K Ca II emission. It is suggested that both effects could be due to mass loss from the companion stars that are now white dwarfs. (auth)

19120 PHOTOMETRY OF SELECTED FLARE STARS IN THE PLEIADES. Erastova, L. K. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 28-42(1972). (In Russian).

Photometric data are given for 22 flares observed between September 1968 and March 1971 in 19 selected flare stars of the Pleiades cluster. A 21-in. telescope was used, covering stellar magnitudes 16.5 to 17.0 mpg during a combined observation time of about 180 h. Flare photographs are also included. (IAA)

19121 NEW FLARE STARS IN THE PLEIADES. I. Parsamian, E. S. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 3-13(1972). (In Russian).

Observation of 17 new flare stars with seven events of repeated flares were made in 1967 through 1970 on the 21 and 40-in. telescopes of the Biurakan Observatory. The magnitudes of the stars and the brightness of the flares were determined. Flare photographs are included. (IAA)

19122 EQUILIBRIUM STRUCTURE OF POLYTROPES WITH TOROIDAL MAGNETIC FIELDS. Miketinac, M. J. (Univ. of Cape Town). Astrophys. Space Sci.; 22: No. 2, 413-419(Jun 1973).

Structure equations for the equilibrium of the gaseous polytropes with toroidal magnetic fields are solved numerically for two values of polytropic index n = 1.5 and 3, using a variant of Stoeckly's method. In addition to the structure parameters frequencies of the characteristic modes of oscillation are calculated. The results are considerably different from the values obtained by Anand for weak toroidal fields. (auth)

19123 COMMON CONVECTIVE ENVELOPE MODEL FOR W URSAE MAJORIS SYSTEMS AND THE ANALYSIS OF THEIR LIGHT CURVES. Lucy, L. B. (Columbia Univ., New York). Astrophys. Space Sci.; 22: No. 2, 381-392(Jun 1973).

From 16th IAU colloquium; Philadelphia, PA (8 Sep 1971).

The common convective envelope model for W UMa systems was used to analyze the light curves of the sixteen systems with spectroscopic mass ratios. From the derived photometric elements, an indication was found that Binnendijk's W-type systems have only shallow common envelopes, which is therefore suggested to be the cause of the difference between A- and W-type systems. It is also suggested that the structure of many contact binaries permits only a shallow common envelope and that further study of such envelopes will yield the modification in the model required if a closer fit to the W-type light curves is to be obtained. The model was also used with mass ratio as an additional photometric element to analyze the light curve of AW UMa. The solution obtained confirmed the remarkably small mass ratio of 0.08 found by Mauder and by Mochnacki and Doughty. (auth)

19124 STELLAR ENVELOPES WITH SUPERCRITICAL LUMINOSITY. Bisnovatyi-Kogan, G. S. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 22: No. 2, 307-320 (Jun 1973).

The analytical solutions are obtained for static envelopes at radiative equilibrium for power dependence of opacity on the temperature. The existence of an exact boundary is shown to lie between the regions of static radiative envelopes and stationary outflowing envelopes for which the asymptotic numerical solutions are found. It is shown that convection makes the static envelope region broader and leads to the existence, for the same parameters, of outflowing and static convective envelopes, i.e., to double-valued solution. The approximate method is indicated for the definition of the boundary of the beginning of the outflow. It is pointed out that the results are, on the whole, applicable to the real cases of the dependence of opacity on the temperature and density. (auth)

19125 EXTINCTION AND SCATTERING BY SMALL PLANETESIMAL PARTICLES. Nandy, K.; Wickramasinghe, N. C. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 23: No. 1, 51-54(Jul 1973).

Computations are presented for the extinction and scattering properties of small planetesimal particles consisting of iron cores and silicate mantles. The possible relevance of such calculations to the observed properties of T Tauri-like stars is discussed. (auth)

19126 PION CONDENSATION AND THE MEISNER EFFECT IN SUPERDENSE NEUTRON STARS. Manassah, J. T. (American Univ., Beirut). Phys. Lett.; 45A: No. 5, 375-376(22 Oct 1973).

The pion condensation in superdense neutron stars is at the origin of a Meisner effect with a very small London penetration depth. (auth)

19127 CURVATURE EFFECTS IN EXTENDED STELLAR ATMOSPHERES: ABSORPTION AND SCATTERING. Peraiah, A. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 23: No. 1, 159-172(Jul 1973).

The numerical solution of radiative transfer equation including curvature with both absorption and scattering was developed in the framework of discrete space theory. Two cases were considered: (A) irradiation of the atmosphere at $\tau = T$ and (B) no irradiation on either side of the atmosphere. Isotropic scattering was assumed. It was found that the emergent luminosities (defined by $\int r^2 I(r, \mu) d\mu$) from scattering dominated atmospheres were smaller than those from absorption dominated atmospheres. (auth)

19128 COMPOSITE SPECTRUM OF THE STAR HD 35450. Khamdi, M. A. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 3, 593-596(Sep 1973). (In Russian).

Spectroscopic and spectrophotometric study of the star HD 35450 has revealed its composite spectrum to be due to the fact that HD 35450 is actually a physically binary system whose components are two stars of the main sequence belonging to the spectral classes A3 and F6. The studied absolute energy distribution in the spectrum of the system in question is in agreement with the mentioned spectral classes. (auth)

19129 INTERACTION OF THE X-RAY SOURCE RADIATION WITH THE ATMOSPHERE OF THE NORMAL STAR IN CLOSE BINARY SYSTEMS. Basko, M. M.; Sunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 23: No. 1, 117-158(Jul 1973).

The structure of the stellar atmosphere irradiated by an x-ray source is calculated. On the basis of these numerical calculations an approximate theory of the x-ray reprocessing is formulated. The interaction of x rays with the stellar atmosphere induces a considerable stellar wind. However, the main part of the x-ray energy is reemitted. The optical appearances of the close binary system including an x-ray source are discussed. The light curve of such a system is obtained. The mass-loss rate of a star with the size close to that of its Roche lobe is evaluated in the isothermal approximation. Most likely, the accretion of matter on to a neutron star, or a black hole, is the cause of the x-ray luminosity. The accreting matter is supplied with the mass outflow from the normal component induced by x rays. The x-ray luminosity is shown to have an upper limit stipulated by the outflow saturation. The model of HZ Her = Her X1 system is constructed which accounts for the observed light curve. The optical appearances of the system are due to the x-ray heating of the face of the x-ray source area of the normal star. The radiation of this hot area is partly reflected by the surface of the disc around the x-ray source. The thin disc is formed by the accretion of matter by the x-ray source. The effective reflection of hard x rays ($h\nu \sim 15$ to 30 keV) by the stellar surface is considered. This phenomenon makes it possible to detect those x-ray pulsars whose beam does not intercept the Earth. The model of Sco X1 as a black hole in a close binary system is discussed. (auth)

19130 BINARY AND MULTIPLE SYSTEMS OF STARS. Batten, A. H. International Series of Monographs in Natural Philosophy. Volume 51. Elmsford, NY; Pergamon Press, Inc. (1973). 288p. $12.00.

A critical review of recent research into the subject of binary and multiple star systems is presented and a survey of the study of these phenomena is provided. The theory developed on the basis of recent research into the statistical and dynamical properties of binary systems which suggests that stellar formation and the distribution of different types of stars are directly influenced by the disturbed evolution of binary components is examined. A critical assessment of the determination of the apsidal constant is also included. (WDM)

19131 BINARY HELIUM DWARF SUPERNOVAE. Mazurek, T. J. (Yeshiva Univ., New York). Astrophys. Space Sci.; 23: No. 2, 365-383(Aug 1973).

The possibility of helium dwarf evolution to sufficiently high densities for violent helium ignition in low-massed binary systems is investigated. During accretional evolution the occurrence of thermonuclear runaway is found to be probable when the dwarf's mass approaches 1 $M_\odot$, and steady-state discontinuous wave propagation considerations indicate that the dwarf is totally incinerated (i.e., its total mass burns to nuclear equilibrium) by a detonation wave. A numerical stellar dynamic investigation, including the full effects of nuclear statistical equilibrium and electron capture indicates total disruption for all reasonable dwarf central densities. For consistency with the cosmic element abundances, the conclusion of total disruption requires a low frequency for helium supernova events, implying that helium ignition in mass exchanging binaries must occur at the lower densities of the relatively mild helium flash. (auth)

19132 NUCLEI OF PLANETARY NEBULAE AND WHITE DWARF ENVELOPES. Kovetz, A. (Tel-Aviv Univ., Israel); Shaviv, G. Astrophys. Space Sci.; 23: No. 2, 385-390(Aug 1973).

Upper bounds to the masses of He envelopes of white dwarfs were derived by examining the maximum He envelope that a nucleus of a planetary nebulae can have consistent with observation. (auth)

19133 SIX-COLOR OBSERVATIONS OF THE ECLIPSING BINARY AR CAS. Gordon, K. C.; Kron, G. E. (Naval Observatory, Flagstaff, AR). Astrophys. Space Sci.; 23: No. 2, 403-416 (Aug 1973).

Depths and phases of both minima of AR Cas in six colors in 1959 are presented. Analysis leads to a color distribution for the secondary component which corresponds to spectral type A5-A7. (auth)

19134 ASYMPTOTIC SOLUTIONS FOR THE CLAIRAUT EQUATION IN THE THEORY OF ROTATING FLUID MASSES. Kopal, Z.; Lanzano, P. (Naval Research Lab., Washington, DC). Astrophys. Space Sci.; 23: No. 2, 425-429(Aug 1973).

A procedure has been devised to construct a solution of the

Clairaut equation in the form of an asymptotic expansion in terms of descending powers of $\lambda = j + \frac{1}{2}$, where j denotes the order of spherical-harmonic distortion. It has been shown that as j and, therefore λ increases, the foregoing series approaches asymptotically a solution of the equation. The procedure is similar to the WKB-method of theoretical physics. (auth)

19135 FOUR SOUTHERN A-TYPE SUPERGIANTS. Buscombe, W. (Northwestern Univ., Evanston, IL). Astrophys. Space Sci.; 23: No. 2, 431-441(Aug 1973).

Measures of line intensities from high-dispersion spectrograms of HD 92207, 100262, 125835, and 161912 are presented. Analysis with a theoretical curve of growth leads to the selection of parameters for excitation temperature and microturbulence. The turbulent velocity in the atmosphere of HD 92207 varies through a factor of two in approximately one month, in phase with a similar change in the equivalent width of Hγ. The spectra of the other three stars do not appear to vary, but the turbulent velocity is much less for Fe I than for Fe II and Cr II. (auth)

19136 WEAK FRICTION APPROXIMATION AND TIDAL EVOLUTION IN CLOSE BINARY SYSTEMS. Alexander, M. E. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 23: No. 2, 459-510(Aug 1973).

The dynamical problem of tidal friction in a binary system consisting of deformable components was studied, with the restriction that the angle of lag or advance of the tidal distortion with respect to the direction of the disturbing companion is small. The fractional distortion of the bodies due to rotation and tidal interaction was treated as a first-order small quantity, and terms up to the fourth harmonic in the tidal potential were retained. In this linear approximation, the time-dependent tidal potential can be Fourier decomposed into a spectrum of simple harmonic terms, each of which is responsible for raising a "partial wave" in the body; each such partial wave can then be treated independently of the others. This is the method first employed by Darwin. (WDM)

19137 SPECTRA OF SOUTHERN STELLAR PLANETARY NEBULAE AND PECULIAR EMISSION-LINE STARS WITH INFRARED EXCESSES. Swings, J. P. (Institut d'Astrophysique, Cointe-Ougree, Belgium). Astrophys. Lett.; 15: No. 2, 71-74(Oct 1973).

Low-excitation forbidden-emission lines are detected in the spectra of three stellar planetary nebulae and three peculiar emission line objects for which infrared photometry had revealed a large 1.6 μm (H) − 2.2 μm (K) color index. (auth)

19138 POSSIBLE STELLAR EVOLUTIONARY LINK TO BLACK HOLES. Wheeler, J. C.; Rosenwald, R. D. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. Lett.; 15: No. 2, 75-77(Oct 1973).

The suggestion has been made that stars with collapsing iron cores may be unable to explode, and hence may generate black holes. The situation when the collapsing core is rotating and magnetized is investigated and it is tentatively concluded that these effects make the situation even more conducive to the formation of black holes. (auth)

19139 SPATIAL DISTRIBUTION OF THE INFRARED EMISSION FROM NGC 7027. Becklin, E. E. (Hale Observatories, Pasadena, CA); Neugebauer, G.; Wynn-Williams, C. G. Astrophys. Lett.; 15: No. 2, 87-90(Oct 1973).

The apparent brightness distribution of the planetary nebula NGC 7027 at 10 μm is essentially identical to that at radio wavelengths, and unlike that at visual wavelengths. The hot dust that presumably gives rise to the infrared emission is mixed with the ionized gas and is thick enough to absorb a significant number of potentially ionizing photons from the central star. It is probable that the heated dust condensed out of the stellar ejecta is unrelated to the cold dust seen in front of the nebula. (auth)

19140 ORIGIN OF THE FLUCTUATIONS OF DENSITY AND OF THE RADIAL FILAMENTS IN PLANETARY NEBULAE. Pikel'ner, S. B. (Sternberg Astronomical Inst., Moscow). Astrophys. Lett.; 15: No. 2, 91-96(Oct 1973).

Strong fluctuations of density should be contained by some external pressure. The following model is considered: a wind from the central star is stopped at a shock front. The high-temperature, rarefied gas behind this front pushes a thin, dense shell of H II, with the shock at another (front) side. Weak initial fluctuations of density deform the shock, and thin filaments with a head at the inner end are formed. The emission measure and radioemission of such nebulae, the presence of several shells, and the high-velocity internal motions are discussed. The model may be applied also to the expansion of a relativistic gas with a magnetic field in an external medium. (auth)

19141 SECULAR STABILITY OF RAPIDLY ROTATING STARS OF ARBITRARY STRUCTURE. Kopal, Z. (Naval Research Lab., Washington, DC). Astrophys. Space Sci.; 24: No. 1, 145-174(Sep 1973).

Poincare's criteria were utilized to investigate secular stability of self-gravitating configurations, of arbitrary structure, in the state of rapid rotation. The potential energy, a knowledge of which is necessary for application of these criteria, was determined by an extension of Clairaut's method; and its evaluation in terms of suitably chosen generalized coordinates carried out explicitly to quantities of fourth order in superficial oblateness, for configurations of arbitrary internal structure. The method employed can, moreover, clearly be extended to attain accuracy of any order — at the expense of mere manipulative work which lends itself to machine automation; and the angular velocity of axial rotation can be an arbitrary function of position as well as of the time. An application of the results to homogeneous configurations in rigid-body rotation was undertaken to demonstrate that the method, when applied to a case for which a closed solution exists, leads to results which are consistent with it. (auth)

19142 PHOTOMETRIC STUDY OF THE ALGOL SYSTEM Y PISCIUM. Walter, K. (Univ., Tuebingen, Ger.). Astrophys. Space Sci.; 24: No. 1, 189-214(Sep 1973).

From 16th IAU colloquium; Philadelphia, PA (8 Sep 1971).

From the discussion of 417 photoelectric observations of this semi-detached Algol system, obtained in B and V during 82 nights in 1965–1971, the existence of a gas stream may be inferred for the following reasons: The scatter of the single observations is dependent on the orbital phase; the largest scatter occurs at the phases following both eclipses. The conventional photometric solution which is based on the "long region rectification" and neglects the photometric influences of the gas stream, gives for the two colors different geometric parameters of the system. However, the "short region rectification" allows a consistent photometric solution. According to this solution a short total phase exists, and the luminous regions caused by the impact of particles of the gas stream are hidden during the central part of the primary eclipse. Outside of eclipses, the additional light is seen during about half of the orbital period. From the variation of the visibility of the additional light during the primary eclipse it may be concluded that during about the first half of the observing time the luminous regions were situated at the high latitudes of the bright component, indicating the existence of magnetic fields on this component at this epoch, whilst later on the additional light came from an equatorial region on the following side of the massive component. (auth)

19143 OBSERVATIONAL STUDIES OF 12DD LACERTAE. I. Multiperiodicity and Its Variations. Sato, N. (Akita Univ., Japan). Astrophys. Space Sci.; 24: No. 1, 215-230(Sep 1973).

Analysis of the light curves of 12DD Lacertae obtained during the years 1918–'71 shows that the primary period, P_1, is decreasing at the rate of about 1 s per 500 yr. The secondary period, P_2, is nearly constant but the third and fourth periods, P_3 and P_4, appear unstable with some irregular changes in frequency and amplitude. It is confirmed that the color in the primary variation is bluest around the phase of a half quarter before maximum light, $0.^p875$. The third variation also shows a similar tendency in color, while the secondary and fourth variations do not seem to show any meaningful color change, presumably indicating that the latter two are different from the pulsational nature of the primary and third variations. The method of power spectrum analysis is further applied to examine the structure of the multiperiodicity in more details and to search for any unknown periods in the light variation. (auth)

19144 MAGNETIC FIELDS AROUND HIGHLY MAGNETIZED OBJECTS. Ferrari, A.; Trussoni, E. (Univ., Turin). Astrophys. Space Sci.; 24: No. 1, 3-15(Sep 1973).

The structure of the magnetic fields of a collapsed star is studied by tracing the flux lines in the quasi-vacuum approximation. The existence of a magnetic neutral line in a system of reference corotating with the star is studied, where magnetic energy dissipations into particle kinetic energy via plasma instabilities could occur. (auth)

19145 NONADIABATIC OSCILLATIONS OF GASEOUS SYSTEMS IN HYDROMAGNETICS. Pineault, S.; Anand, S. P. S. (Univ. of Toronto). Astrophys. Space Sci.; 24: No. 1, 105-115 (Sep 1973).

The general variational principle obtained by Unno for the study of stellar stability is extended to include the effects of magnetic fields in the general case where the perturbations are nonadiabatic. The unperturbed configuration is nonrotating, but internal motions are possible. A general stability equation is derived, using the modified variational principle. In the simplest case, this equation is identical to the one derived by Unno except for the appearance of magnetic terms in one of the coefficients (through the Lorentz

force). If dissipation is neglected, the characteristic equation reduces to the one derived by Frieman and Rotenberg in the stationary case and by Kovetz in the static case. The stability of magnetic stars against homologous oscillations is examined and the usual result for the dynamical mode is obtained. (auth)

19146 ROTATING ISOTHERMAL CONFIGURATIONS IN THE POST-NEWTONIAN APPROXIMATION OF GENERAL RELATIVITY. Shara, M. M.; Anand, S. P. S. (Univ. of Toronto). Astrophys. Space Sci.; 24: No. 1, 117-126(Sep 1973).

The equations which govern the structure of a rotating, truncated isothermal sphere in the post-Newtonian approximation of general relativity are derived and solved numerically. Each model is parameterized by both a rotation and a relativity parameter. The density inside the configurations is tabulated and graphed as a function of both distance from the center and colatitude. Relativistic gravitational effects are found to pull the models into states which are considerably more centrally condensed than one predicts classically. Rotation tends to flatten the isothermal configurations into oblate spheroids, though for even the largest rotation parameters the degree of flattening is only a few percent. The computed models may be similar to the cores of relativistic star clusters. (auth)

19147 BD−18° 3437, A NEW SHORT PERIOD ECLIPSING BINARY. Sanwal, N. B.; Sarma, M. B. K.; Parthasarathy, M.; Abhyankar, K. D. (Osmania Univ., Hyderabad, India). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 81-90(Jan 1974).

BD−18° 3437 has been found to be a short period variable and from the nature of its light and color variation it is concluded that it is an eclipsing binary of W UMa type with depths of minima of 0.20m and 0.18m and a period of 0.3166386 days. After rectification the depths of the minima were found to be too shallow, indicating that the light variation of this system is mainly due to the ellipticity and reflection effects. There are night to night variations in the light curves and the system became fainter by about 0.06m in 1972 compared to 1971. These complications in the light curves may be associated with the intrinsic variation of one or both the components or they may be due to a change in the envelope surrounding the system. (auth)

19148 UBV PHOTOMETRY OF EU TAU. Sanwal, N. B.; Parthasarathy, M. (Osmania Univ., Hyderabad, India). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 91-97(Jan 1974).

UBV observations of EU Tau are presented, and it is confirmed that EU Tau is a classical cepheid variable with a period of 2.10250d. (auth)

19149 UBV PHOTOMETRY OF RV CrV. Abhyankar, K. D.; Parthasarathy, M.; Sanwal, N. B.; Sarma, M. B. K. (Osmania Univ., Hyderabad, India). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 101-108(Jan 1974).

UBV observations of RV CrV made on 11 nights in 1971 are reported. An improved period of 0.7472521 day is found. After rectifying the V light curve by the Russell−Merrill method a tentative photometric solution is obtained by the second method of Kopal. On combining the results with the spectroscopic elements found by Struve and Gratton it appears that the system might be a contact binary. (auth)

19150 SPECTROGRAPHIC OBSERVATIONS OF THE 1971 ECLIPSE OF 32 CYGNI. Bisiacchi, G.; Flora, U.; Hack, M. (Astronomical Observatory, Trieste, Italy). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 109-118(Jan 1974).

Equivalent widths and contours of the chromospheric K−line, together with radial velocities of the metallic lines, hydrogen lines, and K−line, plus the ratio between the continuous flux of B type and K−type stars have been determined using 12.4 Å/mm spectrograms taken during the atmospherical and totality phases of the 1971 eclipse. Cyclic oscillations of the atmosphere with periods of a few days are indicated by the deviations of the radial velocity of the Fe I lines and Balmer lines with respect to the computed orbital velocity. (auth)

19151 PHOTOMETRIC ORBIT OF VZ CYn AND THE VARIATION OF ITS LIGHT CURVE. Ibanoglu, C. (Ege Univ. Observatory, Bornova-Izmir, Turkey). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 119-126(Jan 1974).

A total of 928 photoelectric observations of VZ CVn was obtained in yellow and in blue light during the 1971 and 1972 seasons. Some variations in its light curve were detected and are discussed. Nine epochs of minima were obtained and from these improved light elements were derived. The light curves were analyzed and consistent geometric elements for the system were derived from each light curve. (auth)

19152 DIFFERENTIAL UBV PHOTOMETRY OF SW LAC. Muthsam, H.; Rakos, K. D. (Univ., Vienna). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 127-132(Jan 1974).

Differential UBV observations of the W UMa-type variable SW Lac obtained in autumn 1960 with the 42" reflector at Lowell Observatory are presented. Times of minimum light are calculated from the observations. (auth)

19153 UBV OBSERVATIONS OF MIRA VARIABLES NEAR MAXIMUM LIGHT. Koester, D. (Univ., Kiel). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 133-141(Jan 1974).

UBV observations are presented for 14 Mira variables near maximum light and further observations of about 15 variables made at the European Southern Observatory in Chile. (auth)

19154 NOVA DELPHINI 1967: SPECTRAL SYSTEMS. Malakpur, I. (Institut d'Astrophysique, Paris). Astrophys. Space Sci.; 24: No. 2, 577-583(Oct 1973).

The different absorption systems of Nova Delphini 1967 were identified by studying the radial velocity variation of the absorption lines with time. The "premaximum" system was visible at the time of the first observation and its velocity decreased very quickly in the early stages of the Nova's development. This velocity started to increase from 16 January, 1968. It is shown that the "diffuse-enhanced" system overtook the "premaximum" system and caused its velocity to increase. The "principal" system became visible on August 27, 1967, and showed a continuous slow increase of the radial velocity, with a sudden increase near April 21, 1968, due to a collision between the "principal" and the "diffuse-enhanced" systems. The "diffuse-enhanced" system, visible from December 17, 1967, disappeared on April 21, 1968. The "diffuse-enhanced" system overtook and merged with the principal shell on April 21, 1968. Finally, it was seen that the "Orion" system became visible on May 11, 1968 and disappeared on August 9, 1968. This is not due to a collision, but could be produced by a change of the degree of ionization of the absorbing atoms or by the decrease of the density of the cloud of gas responsible for this system. There were also some absorption systems having a constant velocity, only visible for lines of Ca II. These systems could be produced by ejection of circumstellar gas. It is shown that the Nova entered the nebular stage around July 28, 1968. (auth)

19155 DISTRIBUTION OF FAINTER STARS IN THE OPEN CLUSTER NGC 2477. Lohmann, W. (Astronomisches Rechen-Institut, Heidelberg). Astrophys. Space Sci.; 24: No. 2, 531-533 (Oct 1973). (In German).

The relative frequency of the fainter stars increases from the center of the cluster to the boundary. (auth)

19156 STUDY OF APPARENTLY NEARBY STARS WITH COINCIDING SPECTRAL TYPE AND APPARENT MAGNITUDE. Loden, L. O. (Uppsala Univ.). Astrophys. Space Sci.; 24: No. 2, 511-529(Oct 1973).

At visual inspection of objective-prism plates one frequently detects a pair or higher multiple of apparently identical stellar spectra so close together that they form a conspicuous configuration for the eye. An attempt to analyze this type of object has given no positive indication that it should be identified with any unique physical phenomenon. A series of explanations is presented. A minor fraction of the objects may constitute widely separated binary components, the identity of which is physically conditioned by the process of formation. For the majority, however, it seems more probable that they form parts of cluster remnants or very small clusters, and that the coincidence of the spectral types is in the first instance to consider as a fortunate random effect that facilitates the detection of the hidden cluster. Although there are several interpretations of the appearance of such "miniclusters", it is found particularly important to take the possibility into consideration that the number of open clusters (and associations) may be considerably greater than one has hitherto assumed—from observational as well as from theoretical points of view. (auth)

19157 WHICH ELECTROMAGNETIC EQUATIONS APPLY IN ROTATING COORDINATES. Webster, D. L.; Whitten, R. C. (Ames Research Center, Moffett Field, CA). Astrophys. Space Sci.; 24: No. 2, 323-333(Oct 1973).

It was discovered some years ago by Schiff that the equations $\mathrm{div}E = 4\pi\rho$ and $\mathrm{curl}B - (1/c)\,\partial E/\partial t = (4\pi/c)\,J$ for fields in vacuum do not carry over without change from an inertial frame to a frame with rotating axes of space coordinates, even for a region with all velocities of order $v \ll c$. However, the belief that all four of the field equations are invariant under such conditions is still prevalent and causes misconceptions in physical applications, including astrophysical and geophysical ones. The purpose of the present paper is therefore to call attention to Schiff's discovery, discussing its basis and its extension to fields in material media, and to interpret the additional terms that must be added to the equations in order to obtain valid transformations to rotating axes of coordinates. (auth)

19158 CHANGES OF THE PROFILES OF SPECTRAL LINES DUE TO MASS TRANSFER IN CLOSE BINARIES. Sima, Z. (Charles Univ., Prague). Astrophys. Space Sci.; 24: No. 2, 421-448(Oct 1973).

The model of the ring envelope round the primary component and the stream of the gaseous mass flowing from the secondary component to the primary was constructed on the basis of theoretical computations concerning the exchange of the mass between the components of the binary. The influence of the gaseous mass on the profiles of spectral lines before and after occultation, and the influence of the stream on the profile in case the secondary is near elongation was investigated. The line profiles obtained by numerical computations showed that their changes caused by outflowing mass should be well detectable from spectrograms taken at particular phase of the binary. Changes in the lines may influence the measurement of radial velocities. The method for distinguishing the influence of the stream from the influence of the ring is described. (auth)

19159 SLOWLY ROTATING RELATIVISTIC STARS. IX. Moments of Inertia of Rotationally Distorted Stars. Hartle, J. B. (Univ. of California, Santa Barbara). Astrophys. Space Sci.; 24: No. 2, 385-405(Oct 1973).

Equations are given which determine the moment of inertia of a rotating relativistic fluid star to second order in the angular velocity with no other approximation being made. The equations also determine the moment of inertia of matter located between surfaces of constant density in a rotationally distorted star; for example, the moments of inertia of the crust and core of a rotationally distorted neutron star can be calculated in this way. The method is applied to $n = ½$ relativistic polytropes and to neutron star models constructed from the Baym-Bethe-Pethick-Sutherland-Pandharipande equation of state. (auth)

19160 GAS-LIQUID PHASE TRANSITIONS AND CRITICAL POINT IN HOT WHITE DWARF MATTER. De Cesare, L. (Osservatorio Astronomico di Capodimonte, Naples); Forlani, A.; Platania, G. Astrophys. Space Sci.; 21: No. 2, 461-474(Apr 1973).

The gas-liquid first-order phase transitions are considered, and the existence of the critical point in white dwarf matter is proven. The latent heat released in the liquefaction processes can be used in the interpretation of the spreading of the white dwarf sequence in H-R diagram. Some thermodynamic quantities, e.g., the saturation pressure, the latent heat, etc., are calculated along the gas-liquid coexistence curve, and their behaviors near critical point are studied. (auth)

19161 EQUI-DENSITY SURFACES IN SYNCHRONOUSLY ROTATING CLOSE BINARIES BUILT ON POLYTROPIC MODEL $\nu = 3$. Green, L. C.; Kolchin, E. K. (Haverford Coll., PA). Astrophys. Space Sci.; 21: No. 2, 285-288(Apr 1973).

A direct numerical method, involving no perturbational procedures, is described and used for the computation of the surfaces of constant potential, pressure and density in synchronously rotating close binaries with both components built on polytropic model $\nu = 3$. (auth)

19162 PHOTOMETRIC EFFECTS OF GAS STREAMS IN ALGOL SYSTEMS AND THEIR INFLUENCE ON THE LIGHT CURVES OUTSIDE OF AND WITHIN ECLIPSES. Walter, K. (Univ., Tuebingen, Ger.). Astrophys. Space Sci.; 21: No. 2, 289-305(Apr 1973).

From 16th IAU colloquium; Philadelphia, PA (8 Sep 1971).

An attempt is made to interpret the distortions of the light curves of semi-detached Algol systems, in terms of the absorption effects of gas streams and of the emission from the impact regions of these streams. Hypothetical models of the distortions of the light curves outside of primary eclipses are given for different locations of the luminous regions. To exhibit features of light curves of this kind, both published and unpublished observations (TW Dra, Y Psc, TV Cas) of Algol systems are used. The existence of luminous regions is also indicated by observations of primary eclipses. For some systems (SW Cyg, RV Oph, W Del) it is shown that observations from earlier epochs may be represented by photometric solutions which are based on identical geometric parameters (radii, inclination of orbit) but imply a changed behavior of the gas stream. It is suggested that two kinds of luminous regions exist: regions near the equatorial belt on the following side of the bright component; and regions which tend to occur at the higher latitudes of this star, possibly indicating the existence of magnetic fields. (auth)

19163 PHOTOMETRIC AND SPECTROSCOPIC STUDY OF SILICON AP-STAR HD 193722. Aslanov, I. A. (Shemakha Astrophysical Observatory, USSR); Heildebrandt, G.; Khokhlova, V. L.; Shoeneich, W. Astrophys. Space Sci.; 21: No. 2, 477-485(Apr 1973).

The period of light variation $P = 1^d.13316$ was found for the silicon B9 IVp star HD 193722. Spectroscopic study of this star was based on 35 spectrograms with dispersion 4 Å mm^{-1} well distributed in phase. The measurements of radial velocities of spectral line components for Si II, He I, Eu II, Fe II and Sr II allowed one to localize several regions on the surface of the star with enhanced abundance of these elements. The phase of maximum light in U, B and V was found to be the same as the phase of maximum Eu abundance. The coincidence of the regions with larger abundance of Si and He in HD 193722 disagrees with the hypothesis of diffusion in the presence of a magnetic field developed by Michaud (1971), to explain the peculiar chemical composition of Ap-stars. HD 193722 is a silicon B9 IVp star for which the magnetic field has not been measured. In the list by Palmer et al. (1962) its rotational velocity V sin i is given as 250 km s^{-1}. As will be seen below, this value is too high. Megessier (1971) determined from hydrogen line profiles and continuous spectrum $T_{eff} = 13,000°$ and lg g = 3.5. The results of photometric and spectroscopic study of HD 193722 are given below. (auth)

19164 RADIATIVE TRANSFER IN ATMOSPHERES OF ALGOL-TYPE BINARIES. Departures from the State of LTE in Late-Type Components. Pustylnik, I.; Toomasson, L. (Inst. of Physics and Astronomy, Tartu). Astrophys. Space Sci.; 21: No. 2, 495-503 (Apr 1973).

Departures from the state of LTE in the atmospheres of the secondary components of Algol-type binaries due to anisotropy of irradiation are investigated. Temperature inversion and the abnormal law of limb darkening are the most serious consequences of anisotropy of irradiation if the ratio of the effective temperatures of the components exceeds 2 to 2.5, providing that collisions can be neglected. (auth)

19165 ENVELOPES IN ECLIPSING BINARY SYSTEMS. Huang, S. S. (Northwestern Univ., Evanston, IL). Astrophys. Space Sci.; 21: No. 2, 263-283(Apr 1973).

From 16th IAU colloquium; Philadelphia, PA (8 Sep 1971).

A discussion is given of the relevance of envelopes to the study of the light curves of eclipsing binaries, the disk envelope, and the spherical envelope. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 19129 and 19488.

19166 OPTICAL POSITIONS FOR 24 RADIO SOURCES. Argue, A. N.; Kenworthy, C. M.; Stewart, P. M. (Cambridge Univ., Eng.). Astrophys. Lett.; 14: No. 2, 99-104(Jun 1973).

Positions were measured photographically for 24 specially selected radio objects, and compared with accurate 2695-MHz positions. Six objects showed significant differences which, when combined with other data, suggested the morphology of these objects. Eleven objects that showed no significant differences may be suitable as astrometric reference points; the remainder are unsuitable because of finite resolution. (auth)

19167 QUASAR REDSHIFTS AND PECULIAR VELOCITIES. Dehnen, H.; Obregon, O. (Univ., Konstanz, Ger.). Astrophys. Lett.; 14: No. 2, 91-97(Jun 1973).

For quasars with high peculiar velocities the functional relations among the cosmological redshift, the peculiar velocity, and the change of the angular separation are given. The results are applied to the quasar 3C 279, assuming three different models for this object. In the special case in which the optical source of this object is co-moving with one of the separating radio components, a drastic reduction of the distance of this object by about 67 per cent would be necessary. This harmonizes with the observations of quasar-galaxy pairs. (auth)

19168 OBSERVATION OF GAMMA RADIATION OF THE SOURCE CYG X-3 IN OCTOBER 1972. Gal'ner, A. M.; Kirillov-Ugryumov, V. G.; Kurochkin, A. V.; Luchkov, B. I.; Yurkin, Yu. T. (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 4, 129-130(20 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 4, 217-220(20 Aug 1973).

The paper deals with the observation of gamma radiation of energy higher than 40 MeV, from the cosmic source in the Cygnus constellation, from which several flares of radio and ir emission were registered in September and October 1972. The results were obtained with a high-aperture gamma telescope with spark chambers, carried aloft with a high-altitude balloon. The measured value of the gamma flux from the source is given. It is indicated that the source may be variable. (auth)

19169 POLARIZATION AND BRIGHTNESS DISTRIBUTIONS ACROSS IC443 AND W44 AT 11-cm WAVELENGTH. Baker, J. R.; Preuss, E.; Whitcoak, J. B. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 14: No. 2, 123-127 (Jun 1973).

The distribution of polarization and total intensity across IC443 and W44 were observed at a wavelength of 11 cm with a resolution of 4.8 arc min. IC443 showed strong depolarization over the associated bright nebulosity, but relatively high polarization where there were no optical features. W44 had polarization with a brightness distribution similar to that of the total intensity, and with a fairly uniform change in position angle of polarization across the source. (auth)

19170 OPTICAL SPECTRUM OF THE RADIO SOURCE B2 1101 + 38. Ulrich, M. H. (Univ. of Texas, Austin). Astrophys. Lett.; 14: No. 2, 89-90(Jun 1973).

Low-dispersion spectra of the optical counterpart of the radio source B2 1101 + 38 show continuum emission only. The absence of discrete features in the optical spectrum suggests that this object may be of the BL Lac type. (auth)

19171 PULSAR FLUX DENSITY VARIATIONS AND SPECTRA. McLean, A. I. O. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 133-148(1973).

Observations of pulsar flux densities were made at frequencies between 150 and 1612 MHz, with particular emphasis on smoothing out interstellar scintillation. Pulsars are found to be steady in intensity for several hours, but to be highly variable from day to day and month to month. The day-to-day variation is sometimes correlated at 150, 240, and 408 MHz. The flux density spectra fall steeply above 408 MHz but are less steep below 408 MHz. Accurate spectral index measurements between 240 and 408 MHz revealed a correlation between spectral index and luminosity density. (auth)

19172 DISTRIBUTION FUNCTION OF RELATIVISTIC ELECTRONS IN A STRONG MAGNETIC FIELD. Suvorov, E. V.; Chugunov, Yu. V. (Radiophysical Research Inst., Gorky, USSR). Astrophys. Space Sci.; 23: No. 1, 189-199(Jul 1973).

The motion and radiation of relativistic particles with radiation reaction in a strong magnetic field was considered. The kinetic equation determining the relaxation of the distribution function with radiation reaction was investigated. The universal one-dimensional distribution function was found to which any isotropic ultrarelativistic distribution in a strong magnetic field is relaxed. It is of power type ϵ^{-3} for ultrarelativistic energies $\epsilon \gg mc^2$. Estimations were made which indicated that under the pulsar conditions the one-dimensional electron distribution function is likely formed due to radiation losses while for ions the one-dimensionalization is associated with the conservation of the adiabatic invariant. (auth)

19173 CONTINUOUS EMISSION FROM H II REGIONS. The Importance of Electron Scattering as a Source of Continuous Emission from HII Regions. Tenorio-Tagle, G. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 23: No. 1, 221-225(Jul 1973).

The contribution to the continuous emission by electron scattering in an H II region (Pottasch's suggestion) was studied. The phenomenon was evaluated for different cases, and compared with the contribution due to atomic processes. It was proved, taking into account all the possible variables, that the contribution is neglected for typical H II regions in the Galaxy, and in other galaxies. (auth)

19174 COSMIC SOURCES OF X RAYS AND GAMMA RAYS. Truemper, J. (Univ., Tuebingen, Ger.). Mitt. Astron. Ges.; No. 32, 91-106(1973). (In German).

From Astronomical Society scientific meeting; Vienna, Austria (18 Sep 1973).

Aspects of spectral ranges and observational techniques are considered, giving attention to the use of satellites, balloons, and rockets. Observations of gamma quanta from the galactic disk are discussed together with the identification of supernova envelopes as x-ray sources, questions of x-ray source distribution, the spectrum of Cen X-3, the long-term characteristics of Her X-1, and variations in radiation intensity in the case of Cyg X-1. Extragalactic x-ray sources are also examined along with aspects of diffuse background radiation in the x-ray and the gamma-ray ranges. (IAA)

19175 γ RAYS OF 1 TO 10 MeV FROM THE CRAB AND CYGNUS REGIONS. Baker, R. E.; Lovett, R. R.; Orford, K. J.; Ramsden, D. (Univ. of Southampton, Eng.). Nature (London) Phys. Sci.; 245: No. 141, 18-19(10 Sep 1973).

It is stated that as part of a study of techniques for γ-ray astronomy in the MeV range several balloon experiments have been launched by the University of Southampton group from Palestine, Texas. Results are reported here from an experiment launched on September 23rd, 1972. The balloon floated at a depth of 8g/cm^2 for 7 hr from 0600 GMT, and the payload consisted of an anticollimation telescope using two 12cm by 5cm NaI(Tl) crystals mounted side by side, each viewed by a 12cm photomultiplier and protected from charged particles by a plastic scintillator box. Sources tracked were Cyg X-1, Cyg X-2/4, Tau X-1, and Per γ-1. No significant excesses over background were observed from the directions of Cyg X-2/4 or Per γ-1, but significant excesses were observed from the Cyg X-1 and Tau X-1 regions. Wide variations appear to have occurred in the high-energy spectrum of Cyg X-1. Present results show no evidence of steepening of the spectrum and suggest a spectral index of 1.5. The γ rays observed from Tau X-1 and Cyg X-1 are shown tabulated. (UK)

19176 EXCITATION OF CII λ2326, OIII λ1664, AND OTHER SEMI-FORBIDDEN EMISSION LINES IN QUASARS. Jackson, A. R. G. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 53-60(1973).

Accurate collision strengths for the semi-forbidden transitions C^+, N^{2+} $2s^22p\ ^2P^0-2s2p^2\ ^4P$, and N^+, O^{2+} $2s^22p^2\ ^3P-2s2p^3\ ^5S^0$, were calculated using the close coupling approximation and allowing for configuration interaction. Effective collision strengths are presented for these transitions as a function of electron temperature T_e. The significance of these results, for various quasar models, is discussed. (auth)

19177 BALLOON OBSERVATIONS OF SCO X-1 IN THE ENERGY INTERVAL 17 TO 106 keV. Jain, A. K.; Jayanthi, U. B.; Kasturirangan, K.; Rao, U. R. (Physical Research Lab., Ahmedabad, India). Astrophys. Space Sci.; 21: No. 1, 107-116(Mar 1973).

The intensity and spectral nature of the x-ray emission from Sco X-1 in the energy interval 17 to 106 keV are presented, based on the observations made by a balloon-borne scintillation telescope system flown on November 15, 1971, from Hyderabad, India. In the interval from 25 to 53 keV, the spectral distribution is observed to correspond to a kT value of $8.5^{+1.0}_{-0.6}$ keV if the shape is exponential. Over the complete energy range of observation, a power law function with the value of exponent equal to 3.6 ± 0.5 seems to yield an adequate fit. The temporal characteristics of the x-ray emission from Sco X-1 are discussed by comparing the present data with those obtained elsewhere. (4 figures) (auth)

19178 COMPARISON BETWEEN COMPTON-SYNCHROTRON AND COMPTON BLACKBODY EMISSION IN RADIO SOURCES. Albano, J. R.; Terlevich, R.; Frank, J. (Instituto de Astronomia y Fisica del Espacio, Buenos Aires). Astrophys. Space Sci.; 21: No. 1, 177-187(Mar 1973).

A simple relation between observational parameters of radio sources that allows stating the predominance of either the Compton-synchrotron or the Compton black-body effect in the x-ray emission is derived. The results obtained suggest that the Compton-synchrotron contribution is dominant in compact radio sources. (1 figure, 4 tables) (auth)

19179 ESTIMATION OF THE COMPLETENESS OF RADIO SOURCE COVERAGE. Vardanyan, R. A.; Melik-Alaverdyan, Yu. K. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 108-110(1972). (In Russian).

An approximate formula is proposed for radio source distributions in a system of spherical zones as functions of the distance from a radio source which is the center of this system. The use of sequences of such systems is proposed as an approach to the estimation of the completeness of radio source populations in areas covered by observations. (IAA)

19180 STATISTICAL STUDY OF PULSARS. Arutyunyan, E. A.; Melik-Alaverdyan, Yu. K. Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR; No. 44, 111-114(1972). (In Russian).

Statistical analysis shows that the distribution of pulsars according to galactic longitudes differs from that of supernova remnants. It is theorized that this difference may be linked with the motion of pulsars relative to the latter. The existence of a relation between pulsar periods and their radio brightness is indicated. (IAA)

19181 INTERSTELLAR ABSORPTION OF THE LOW ENERGY X RAYS FROM THE CRAB NEBULA. Charles, P. A.; Culhane, J. L.; Tuohy, I. R. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 355-361(1973).

Observations of the soft x-ray emission from the Crab Nebula, made with the MSSL x-ray telescopes on board the satellite Copernicus, require a review of the currently accepted interstellar abundances of light elements. The soft x-ray data imply on a gas column density of $(3.1 \pm 0.5) \times 10^{21}$ atoms cm^{-2} using Brown and Gould (Phys. Rev. D; 1: 2252 (1970)) x-ray absorption cross sec-

tions. Results obtained from 21 cm radio measurements indicate a lower value of the column density. Better agreement between the x-ray and radio values can be obtained by increasing the abundances of helium and neon over those assumed by Brown and Gould. (auth)

19182 IDENTIFICATIONS OF SOUTHERN PARKES RADIO SOURCES. Tritton, K. P.; Whitworth, D. P. D. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 253-257(1973).

A search has been made of the optical fields near 25 Parkes radio sources south of declination -44°. Four new identifications are proposed and two others confirmed. (auth)

19183 IDENTIFICATIONS OF EXTENDED SOUTHERN RADIO SOURCES. Tritton, K. P.; Schilizzi, R. T. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 245-252(1973).

A search has been made of the optical fields near 22 extended or multiple radio sources south of declination -44°. Six new identifications are proposed and one other confirmed. (auth)

19184 OPTICAL FLUCTUATIONS OF SCORPIUS X-1. Frohlich, A. (Tel Aviv Univ., Israel). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 313-321(1973).

The light output from the optical counterpart to the X-ray source Sco X-1 was sampled at intervals of 1 ms, 10 ms, and 10 s in 1972 June. The optical fluctuations were essentially random in the range of periods from 4 to 320 ms while in the period range from 20 to 256 s a significant periodic oscillation at (120.5 ± 1.2) s persisted during four successive nights. This period corresponded to an oscillation of Sco X-1 reported earlier. During one night the light output decreased by half in 25 m; during this decrease the period of the oscillation changed to (118.3 ± 0.8) s. (auth)

19185 EXTRAGALACTIC RADIO SOURCES WITH STEEP LOW FREQUENCY SPECTRA. Baldwin, J. E.; Scott, P. F. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 259-269(1973).

A sample of radio sources at high galactic latitudes with spectral indices $\alpha_{38}^{178} > 1.2$ was selected; 38 per cent were found to be associated with Abell's rich clusters of galaxies. The data support a direct relation between the steep radio spectra and x-ray emission from the clusters. This result is most easily explained by ascribing a thermal origin to the x-ray emission. (auth)

19186 SYNCHROTRON MODEL FOR THE CONTINUUM SPECTRUM OF THE CRAB NEBULA. Burn, B. J. (Univ. of New South Wales, Kensington, Australia). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 421-429(1973).

A simple model is presented for the synchrotron radiation from the Crab Nebula which includes the effects of magnetodynamic activity. By allowing for the energy gain of the relativistic electrons which are temporarily in regions of enhanced field, it is possible to explain the complete spectrum from radio to x-ray frequencies without requiring the continuous injection of electrons of very high energies. The energy requirements for the model are similar to the usual synchrotron model, but the spectrum of the electrons injected from near the pulsar is much simpler. (auth)

19187 INVERSE COMPTON X-RAY GENERATION IN QSS AND THE DISTANCE PROBLEM. Okoye, S. E. (Univ. of Nigeria, Nsukka). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 413-419(1973).

Earlier expressions (Okoye, Mon. Not. R. Astr. Soc.; 160: 339 (1972)) for the inverse Compton x-ray emission expected from nearby radio galaxies are generalized to include sources at cosmological distances. The theoretical results are applied to QSS under the assumption that their redshifts are indicators of distance. It is shown that if the cosmological interpretation of the QSS redshifts is correct, the x-ray luminosities of some selected QSS must have been greater at earlier epochs and the expected Compton x-ray fluxes greater than the corresponding values for a "local hypothesis" model. The importance of the present results, in terms of the problem of the QSS redshifts, is that they suggest a real possibility of distinguishing observationally between the local and cosmological models of QSS by increasing the sensitivities of current X-ray telescopes by one or two orders of magnitude. (auth)

19188 RADIO STRUCTURE OF EXTRAGALACTIC X-RAY SOURCES. Guthrie, B. N. G. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 23: No. 2, 391-401(Aug 1973).

The radio properties of Uhuru x-ray sources with fairly certain extragalactic identifications are described briefly. Radio to x-ray flux ratios are low for rich clusters of galaxies and high for double radio sources. There is some evidence from the Abell 426 (Perseus) and Abell 1367 clusters that a radio galaxy in a rich cluster may be the center of extended x-ray emission. Nuclei of galaxies have an enormous range in x-ray luminosity; the known range is from ~10^{30} W for the Milky Way to ~3×10^{38} W for 3C 273. Unidentified x-ray sources at high galactic latitudes may include new classes of objects with very low radio to x-ray flux ratios or hard x-ray emission. (auth)

19189 KINETICS AND INTEGRAL CHARACTERISTICS OF MAGNETOBREMSSTRAHLUNG RADIATION AT HIGH ENERGIES. Baier, V. N.; Katkov, V. M.; Strakhovenko, V. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 1, 81-95(Jan 1974). (In Russian).

The energy distribution function $\rho(\epsilon,t)$ of particles radiating in a magnetic field during time t is discussed by taking into account quantum corrections on the condition that $\chi \ll 1$(χ is a parameter characterizing quantum effects). The analysis is based on application of the energy distribution moments at time t which were calculated analytically. By employing an interpolation procedure the function $\rho(\epsilon,t)$ is determined on basis of the moments. Integral spectral and angular distributions of the radiation for periods of time during which the particle is in the field are also found with allowance for quantum effects. (auth)

19190 STUDY OF HARD X-RAY EMISSIONS FROM SUPERNOVA REMNANTS. Laros, J. G. La Jolla, San Diego, CA; Univ. of California (1973). 101p. University Microfilms Order No. 73-25,412.

Thesis (Ph. D.).

Four young supernova remnants—the Crab Nebula, SN 1572 (Tycho's Nova), Cas A, and the result of a recent explosion in M101—were observed in the 15 to 300-keV range from balloons in September and October of 1970. The observations employed an actively shielded scintillation-type x-ray telescope having a sensitive area of 34.2 cm^2 and a 5.9° FWHM. Spectra of the total Crab Nebula and NP 0532 were obtained, with the region of highest accuracy being the 25- to 150-keV range. Over this energy interval, best-fit power law spectra were $(21.8 \pm 5)E^{-1.29\pm.05}$ keV $cm^{-2}s^{-1}keV^{-1}$ for the total emission and $(.70 \pm .07)E^{-1.90\pm.20}$ for the pulsar. However, the total emission data obtained over the entire 15- to 300-keV range cannot be fit by a single power law, and consideration of the most accurate data from other experiments in the 1- to 600-keV range indicates that both the pulsed and total emission spectra steepen with energy. Although previous models for the steady Crab Nebula emission at infrared and higher frequencies have been based on the assumption of continuing injection of a power law electron distribution, it is shown that monoenergetic electron injection can also produce a reasonable spectrum whose shape is determined by the configuration of the nebular magnetic field and the evolution of NP 0532. It is generally agreed that a pulsar is a rotating neutron star with a strong non-axisymmetric magnetic field. However, due to the exceedingly complex environment near such an object, the emission from NP 0532 is not yet quantitatively well explained. New 15- to 100-keV upper limits of 2×10^{-4} photons $cm^{-2}s^{-1}$ keV^{-1} were obtained for the hard x-ray emissions from SN 1572 and Cas A. These and other data show that their spectra are steeper than that of the Crab Nebula, but the choice of a particular emission mechanism is not yet possible, with both synchrotron and thermal models being plausible. An equally sensitive upper limit to the hard x-ray output from the supernova in M101 was obtained, and adds to the growing body of evidence that the diffuse x-ray component cannot be due to supernovae in distant galaxies, and that on the average only a small fraction of the energy in a supernova explosion is converted into x radiation. (Diss. Abstr. Int. B)

19191 OPTICAL POSITIONS FOR 44 OBJECTS IDENTIFIED WITH RADIO SOURCES. Wall, J. V. (CSIRO, Sydney). Astrophys. Lett.; 15: No. 2, 101-106(Oct 1973).

The optical positions of 39 quasi-stellar objects and five radio galaxies were obtained from plates of these objects. The positions are on the FK4 system and have a typical standard error of 0.4 arc sec in right ascension and declination. (auth)

19192 NATURE OF THE NEW OH SOURCES DISCOVERED BY WINNBERG ET AL. AT 1612 MHz. Wallerstein, G. (Univ. of Washington, Seattle). Astrophys. Lett.; 15: No. 2, 83-85(Oct 1973).

It is suggested that the nine new type II OH sources discovered by Winnberg et al. (1973) are more likely to be associated with M supergiants than with long-period variables. If that is correct, the comparison of their velocities with the velocity of H I emission suggests that the center of mass velocity for these type II OH sources may lie between the two emission velocities rather than at the velocity of the long-wavelength component. (auth)

19193 SELF-FOCUSSING OF PULSAR LOW-FREQUENCY RADIATION. Wentzel, D. G. (Univ. of Maryland, College Park). Astrophys. Lett.; 15: No. 2, 67-69(Oct 1973).

The low-frequency radiation from pulsars is unstable to break-

up into filaments and is able to penetrate the plasma of a supernova remnant. (auth)

19194 GLOBULAR CLUSTER NGC 2298. Alcaino, G. (Univ. Catolica de Chile, Santiago). Astron. Astrophys., Suppl. Ser.; 13: No. 1, 55-63(Jan 1974).

A UBV photometric investigation of the southern globular cluster NGC 2298 was carried out at the Cerro Tololo Inter-American Observatory using the 1.5 m reflector for the photoelectric and the photographic work. Fourteen stars were observed photoelectrically to apparent magnitude V = 16.22. With this sequence, 60 stars were calibrated photographically. The apparent distance modulus is (m−M) app = 15.70. The reddening is E (B−V) = 0.08. The true distance modulus is $(m-M)_0 = 15.46$. The distance is 12.36 kpc from the Sun, 3.54 kpc from the galactic plane, and 18.72 kpc from the galactic center. The giant branch rises 3 magnitudes above the horizontal branch at $(B-V)_0 = 1.4$, characteristic of a metal poor object. (auth)

19195 SPECTRA OF 373 RADIO SOURCES. Veron, M. P. (Observatoire de Meudon, France); Veron, P.; Witzel, A. Astron. Astrophys., Suppl. Ser.; 13: No. 1, 1-53(Jan 1974).

The spectra of 373 radio sources were studied, using most published flux densities between 10 and 10,000 MHz. Taking into account only the straight spectra, a scaling factor was determined for all the catalogues of flux densities, in order to get a relative but consistent set of scales. These scaling factors were in good agreement with the published scaling factors for frequencies smaller than 3000 MHz. Using the calibration method, however, it was found that the published scales at frequencies larger than 5000 MHz were generally too low and that there was then no trend for the spectra to become steeper at higher frequencies contrary to the finding of other authors (for instance, Kellermann et al. 1969; Kellermann and Pauliny-Toth 1971). (auth)

19196 FORCE-FREE PULSAR MAGNETOSPHERES. Mestel, L. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 24: No. 1, 289-297(Sep 1973).

The equations to the steady, axisymmetric, charged pulsar magnetosphere given recently by Michel (1973a, b) and Scharlemann and Wagoner (1972, preprint) are generalized to nonaxisymmetric systems that are steady in the frame rotating with the pulsar. It is shown that in all nonsingular models with cylindrical (but not axial) symmetry, and with a non-zero magnetic field component parallel to the axis, the magnetic field lines emanating from the pulsar are all trapped within the light-cylinder, so that there is no net electromagnetic energy flow across the light cylinder. (auth)

19197 NEUTRAL HYDROGEN OBSERVATIONS ON HII REGIONS. Bajaja, E. (Instituto Argentino de Radioastronomia, Buenos Aires); Garzoli, S. L. Astrophys. Space Sci.; 24: No. 1, 65-82(Sep 1973).

Nine of the catalogued H II regions in the southern hemisphere were selected for correlation with neutral hydrogen observed at the 21 cm line. The radiotelescope used for the H I line observations was the 30 m Carnegie telescope of the Instituto Argentino de Radioastronomia and the 56 channel, 10 kHz bandwidth receiver. The observational results were analyzed for each H II region. They were compared with previous optical and radio results. For three of the nine observed regions it was possible to find neutral hydrogen in absorption with similar velocities. In three cases absorption was found but no component at the H II region velocity was seen. Finally in three cases, it was not possible to find any absorption at all. (auth)

Solar Phenomena

Refer also to abstracts 19215, 19268, and 19304.

19198 (HMI-B-138) SURVEY OF METEORITE RESEARCH AS OF 1973. Fink, D. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany)). 1973. 129p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

A survey is given of the results in meteorite research of the last few years. Particular emphasis is placed on theories on the origin of meteorites and on the time dependence of meteorite flux rates. Furthermore, problems of the formation of craters are reported. Recent results of Moon and Mars research are included and mineralogic and chemical aspects are briefly touched upon. Chondrules which are enriched with solar wind are treated in great detail. (auth)

19199 FERMI ACCELERATION AND THE ENERGY SPECTRA OF HEAVY NUCLEI AT LOW ENERGIES. Ramadurai, S. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Lett.; 14: No. 2, 85-88(Jun 1973).

The effect of ionization loss on the energy spectra of nuclei undergoing Fermi acceleration is studied. It is found that the shapes of the energy spectra after acceleration are different for different types of nuclei, the higher the charge, the steeper the spectra at low energies. It is shown that the enhanced abundance of O, Si, and Fe recently observed in solar flares may be explained by such a process. (auth)

19200 OBSERVATION OF A TYPE II SOLAR RADIO BURST TO 37 $R_\odot$. Malitson, H. H.; Fainberg, J.; Stone, R. G. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Lett.; 14: No. 2, 111-114(Jun 1973).

For the first time, Type II radio emission has been detected above a height of 5 $R_\odot$ from the center of the Sun. A Type II burst with clearly defined fundamental and second harmonic components was observed with the IMP-6 satellite on June 30, 1971, from 0542 to 0934 UT at frequencies from 1850 to 292 kHz. For a reasonable density distribution in the outer corona and assuming a plasma wave origin for the burst, this frequency range corresponded to heights of 14 to 37 $R_\odot$. The derived average velocity of the burst was 635 km/sec. (auth)

19201 EXTRATERRESTRIAL ULTRAVIOLET RADIATION AND THE PARAMETER OF THE HI MEDIUM NEAR THE SUN. Fahr, H. J.; Lay, G. (Univ., Bonn). Mitt. Astron. Ges.; No. 32, 198-202(1973). (In German).

From Astronomical Society scientific meeting; Vienna, Austria (18 Sep 1972).

It is indicated that extraterrestrial uv radiation at 1216 A can be interpreted as a result of solar radiation scattering at the same wavelength on interstellar neutral hydrogen in interplanetary space. It is theorized that the interstellar HI medium penetrates into the solar system from a certain direction and that its density becomes there anisotropic, the anisotropy level being dependent on the parameters of the HI medium at the time of penetration. This direction and the HI medium velocity can be determined from the structure of Lyman-alpha isophots as measured by the OGO V satellite. (IAA)

19202 CIRCULAR POLARIZED EMISSION FROM SOLAR ACTIVE REGIONS AT MILLIMETER WAVELENGTHS. Edelson, S. (Sonnenobservatorium, Kanzelhoehe, Austria); Shimabukuro, F. I.; Mayfield, E. B. Mitt. Astron. Ges.; No. 32, 178-182(1973). (In German).

From Astronomical Society scientific meeting; Vienna, Austria (18 Sep 1972).

Simultaneous observations of solar radio emission at 9 and 3.5 mm wavelengths and at 3.3 mm were made at Kitt Peak and El Segundo. Based on the analysis of the observations, it is concluded that the S-components at 9 and 3 mm are consistent with optically thin sources, with temperatures within the range of 25,000 to 100,000 K, and electron densities of 5×10^9 to 10^{10}/cu cm and permeated with magnetic fields of the order of hundreds of gauss. In well developed sunspot groups, right and left circularly polarized emission arises from regions of positive and negative polarity, respectively, corresponding to the extraordinary mode of magnetoionic theory. (IAA)

19203 OBSERVATIONS OF SOLAR PARTICLE PROPAGATION. Lanzerotti, L. J. (Bell Telephone Labs., Inc., Murray Hill, NJ). (1973). vp. (In German).

From seventh ESLAB symposium; Saulgau, Ger. (22 May 1973).

A review is given of the observations of the propagation characteristics of solar particles from impulsive flare events that principally have been reported since the Third ESLAB Symposium. The review is limited to current interpretations of the observations in terms of the complete particle transport equation and the recent attempts at reconciling values of the elements of the diffusion tensor as obtained from particle observations and from measurements of interplanetary magnetic field fluctuations. The importance of understanding and modeling the effects of flare-produced shock waves on the diffusive–convective low-energy particle time–intensity profiles is stressed. The present observational data on particle modulations by shock waves is reviewed. (auth)

19204 ANOMALOUS IONIZATION IN THE UMBRAE OF SUNSPOTS. Blackwell, D. E.; Mallia, E. A. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 61-76(1973).

New observations are presented of sunspot spectra in regions containing lines of ionized elements, obtained with the rapid scanning spectrometer at the Oxford–Gornergrat Observatory. The umbral spectra are corrected for scattered light from penumbra and photosphere by making use of scans of the solar limb and sky background. The corrected spectra show anomalously strong lines of Fe II and Cr II. Observation of the anomaly for Fe II depends critically on the accuracy of the scattered light measurement. A numerical experiment showed that the measured value

of 26% for the relevant spot is unlikely to be greatly in error. These anomalies cannot be explained in terms of a nonhomogeneous model of an umbra in which there is a state of L.T.E. in each component, and it seems probable that the lines arise from a nonequilibrium mechanism. The possible presence of a similar anomaly in the spectra of magnetic stars is briefly discussed. (auth)

19205 DO HELIUM INHOMOGENEITIES RESOLVE THE SOLAR NEUTRINO PROBLEM? Demarque, P.; Mengel, J. G.; Sweigart, A. V. (Yale Univ., New Haven). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 19P-20P(1973).

Detailed solar models do not support the conclusion of Prentice (Mon. Not. R. Astr. Soc.; 163:331 (1973)) that the presence of a hydrogen-free core can greatly reduce the neutrino flux from the Sun. (auth)

19206 COMET KOHOUTEK. Biermann, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nature (London); 246: No. 5433, 400-402(14 Dec 1973).

The theme of this discussion is that although comet Kohoutek has not lived up to some of the more extravagant claims made for its astronomical prominence, observations of it will be important since so little is known about the nature of comets. Comets that, like Kohoutek, approach the Sun for the first time, after spending 4.5×10^9 yr most probably in the outer fringes of the Solar System, are generally considered to be the oldest essentially unchanged specimens of the products of condensation in the solar nebula, which nearer to the Sun led to formation of the terrestrial planets or, at somewhat larger distances, of the major planets. For these reasons such comets are likely to provide important clues about the very early history of the Solar System and the way in which it formed from collapsing interstellar matter. Comparisons are made between Kohoutek and other known comets. For the purpose of the discussion presented, hypotheses embodied in the "icy-conglomerate" model are adopted (Astrophys. J. 111: 375 (1950)), involving the concept of the associated gas being present in the central parts of the coma in the form of ice, presumably in a single block. Ultimate verification that the nucleus is really a single body made up of ice and dust, however, can only be provided by a space mission towards the comet. It is pointed out that Kohoutek will be the first comet to be observed with adequate instrumentation in almost every important wavelength range. Some observations which will be made are described. (UK)

19207 SOLAR ENERGY CYCLE AND ITS RELATION TO GEOMAGNETIC ACTIVITY. Kangas, J.; Raychaudhuri, P. (Univ. of Oulu, Finland). Astrophys. Space Sci.; 21: No. 1, 3-5(Mar 1973).

It is suggested that recurrent and nonrecurrent geomagnetic disturbances, which are related to the release of solar magnetic energy in the form of unipolar and bipolar magnetic regions, respectively, are connected with the variations in the solar energy source. The true beginning of the solar cycle takes place when unipolar magnetic regions start to develop, i.e., when nuclear energy generation becomes dominant over the neutrino energy loss according to the photon--neutrino coupling theory. (auth)

19208 MODELS OF FORCE-FREE MAGNETIC FIELDS IN RESISTIVE MEDIA. Bostroem, R. (Royal Inst. of Tech., Stockholm). Astrophys. Space Sci.; 22: No. 2, 353-380(Jun 1973).

A review is given of some of the basic properties of force-free fields under circumstances when the conductivity of the medium is finite. Then the electric current density is related not only to the magnetic field, but also by Ohm's law to the electric field and plasma velocity, which must be considered in the solutions. It is pointed out that the natural constraint that the electric field and plasma velocity should be finite everywhere is not fulfilled in some previously used models. Models with a constant ratio α of the electric current density and magnetic field intensity have been used extensively in the past. They are of some importance since solutions with the plasma at rest are possible only if α is constant. However, it is shown that solutions of constant α cannot be matched to an external current-free region of finite conductivity since α can have no discontinuity in a medium where the conductivity varies continuously. Hence, for most applications models with a varying α and a moving plasma must be used. Some new, simple and consistent models, especially of cylindrical symmetry, are derived by prescribing the form of the magnetic field lines, or one electric field component, or one time-dependent electric current component. (auth)

19209 ABUNDANCES OF THE HEAVY ELEMENTS. Suess, H. E.; Zeh, H. D. (Univ. of California, San Diego, La Jolla). Astrophys. Space Sci.; 23: No. 1, 173-187(Jul 1973).

Abundance regularities for heavy nuclei (A > 58) are investigated and formulated as abundance rules. Abundance values of carbonaceous chondrites of type 1 and 2 as well as most probable values for primordial abundances are listed. The abundance rules definitely require minor corrections of the empirical values. A measurement of the (n,γ) cross-section of Pd^{104} would make possible to decide whether type-1 or type-2 carbonaceous chondrites have a more primitive elemental composition. (auth)

19210 PLASMA THEORY OF RADIO ECHOES FROM THE SUN AND ITS IMPLICATIONS FOR THE PROBLEM OF THE SOLAR WIND. Gordon, I. M. (Inst. of Radiophysics and Electronics, Kharkov). Space Sci. Rev.; 15: No. 2/3, 157-204(1973).

It is demonstrated that the solar radio echo data cannot be understood in the framework of conventional theories of reflections from those coronal layers, where the refraction index n = 0, from moving inhomogeneities or shock fronts. It was found that all peculiar and unexpected features of radio echo spectra can be explained by the theory of its formation and amplification by induced processes of scattering from turbulent pulsations of the coronal plasma. So, the structure of the radio echo spectra brings information, not only about the systematic large-scale motions of coronal plasma, but also about the plasma turbulent pulsation spectrum, its temperature and density as well. It was found also that the reflected signal originates from the disturbed coronal zones situated above active regions while reflections from the quiet corona are weak or completely absent. The analysis of the radio echo spectra shows that in comparatively thin layers of the corona situated above the active regions, rapid acceleration and heating of the solar wind sometimes take place. (WDM)

19211 ZEMNOE EKHO SOLNECHNYKH BUR. (Ground Echo of Solar Storms). Chizhevskii, A. L. Moscow; Izdatel'stvo Mysl (1973). 350p.

A wide range of questions connected with the effects of solar activity on the natural processes of the earth—climatic, geophysical, and biological—is considered. Problems of medical geography and epidemiology occupy a central place in the book. (tr-auth)

19212 FINITE LARMOR RADIUS EFFECTS ON THE STABILITY OF A STRATIFIED PLASMA. Bhatia, P. K. (Univ. of Jodhpur, India). Astrophys. Space Sci.; 23: No. 2, 275-284 (Aug 1973).

The hydromagnetic stability of a cosmical plasma interacting with neutral gas was studied to include the effects of ion viscosity and the finiteness of the ion Larmor radius. It is first shown that the system is characterized by a variational principle. The explicit solution is then obtained, by making use of the existence of the variational principle, for a semi-infinite plasma in which the density is stratified, exponentially, along the vertical. It is found that FLR, ion viscosity as well as neutral gas friction have all a stabilizing influence. (auth)

19213 SPATIAL STRUCTURE OF TRANSVERSE OSCILLATIONS IN THE INTERPLANETARY MAGNETIC FIELD. Chang, S. C.; Nishida, A. (Tokyo Univ.). Astrophys. Space Sci.; 23: No. 2, 301-314(Aug 1973).

The spatial structure of the transverse oscillations in the interplanetary magnetic field at 1 AU was studied by comparing the simultaneous observations by Explorer 33 and 35 satellites at the maximum separation of about 200 R_E. The anisotropy characteristics of these oscillations suggested that the oscillations sampled were Alfvén waves. It was found that the size of the region of the wave coherence was related to the solar wind velocity; the size was ~80 R_E when the wind velocity was lower than ~500 km s^{-1} but became less than this when the wind velocity was higher. An inference was made that the solar atmospheric turbulence contributing to the faster solar wind was finer in scale than that associated with the slower wind. (auth)

19214 CONTRASTREAMING INSTABILITY IN COLLISIONLESS ANISOTROPIC PLASMAS. Aggarwal, S. S.; Talwar, S. P. (Univ. of Delhi). Astrophys. Space Sci.; 23: No. 2, 315-323 (Aug 1973).

The problem of contrastreaming instability in collisionless anisotropic plasmas was investigated both for electrostatic and electromagnetic perturbations propagating along the ambient magnetic field. Both electron–electron and ion–ion streams were considered. It was found that the electromagnetic instability may, under certain conditions, be characterized by larger growth rates than the electrostatic instability. (auth)

19215 ENHANCED DIFFUSION IN STRONGLY MAGNETIZED ASTROPHYSICAL PLASMAS. Lerche, I. (Univ. of Chicago). Astrophys. Space Sci.; 23: No. 2, 339-346(Aug 1973).

It is demonstrated that the diffusion coefficient for low-energy particles, tied to a magnetic field which random walks, may be considerably larger than previously estimated in a strongly magnetized system—like the solar wind or the Galaxy. This is of interest with respect to propagation and lifetime considerations of low-energy cosmic rays in the solar wind and the Galaxy. (auth)

19216 ARIZONA-NASA ATLAS OF THE INFRARED SOLAR SPECTRUM. X. Benner, D. C. (Univ. of Arizona, Tucson); Kuiper, G. P.; Randic, L.; Thomson, A. B. Ariz., Univ. Lunar Planet. Lab., Commun.; 9: No. 3, 155-169(1972).

The second and last set of the B-spectrometer records, concluding the series of the Arizona-NASA Infrared Solar Spectrum Atlas, are presented. The value of the presented series lies primarily in serving as reference to high-altitude planetary spectra taken with similar resolution, 6 to 10,000. The wavelength interval covered is 13,350 to 34,100 A. (IAA)

19217 FROM SOLAR NEUTRINOS TO TERRESTRIAL GLACIATIONS. Boury, A. Ciel Terre; 89: 219-229(1973). (In French).

The theory of the structure and the evolution of the sun is based on the existence, in its interior, of nuclear reactions which liberate enough energy to assure its luminosity during a very long period. Certain of these nuclear reactions are simple beta disintegrations, accompanied by emission of neutrinos whose flow to the earth can be calculated. Classical views of the solar structure are reviewed, and theoretical models and preliminary observations are discussed, as well as new measurements and unconventional models. It is suggested that the Pleistocene glacial age could be attributed to a temporary diminution of solar luminosity. (IAA)

19218 SOLAR NEUTRINO PUZZLE AND THE QUESTION OF SOLAR ABUNDANCES. Kuchowicz, B. (Univ., Warsaw). Astrophys. Lett.; 15: No. 2, 107-108(Oct 1973).

In view of the discrepancy between the theoretical predictions and observational upper limit to the solar neutrino counting rate in Davis's experiment, it is suggested that two standard assumptions used in constructing solar models have to be looked upon with some suspicion: (a) the homogeneous initial composition of the Sun, and (b) the identification of primordial solar abundances with recent surface abundances. (auth)

19219 OBSERVATIONS WITH AN ELECTRO-OPTICAL RADIO SPECTROGRAPH. Cole, T. W. (CSIRO, Sydney). Astrophys. Lett.; 15: No. 2, 59-60(Oct 1973).

The first observations of solar radio bursts made with an electro-optical radio spectrograph are presented. The spectrograph simultaneously analyses a 100-MHz segment of the spectrum with a resolution of 125 kHz. Future developments and applications of the instrument are described. (auth)

19220 DISTANCES TO THE SUPERNOVA REMNANTS IC443 AND MSH11-61A. Dickel, J. R. (Univ. of Illinois Observatory, Urbana). Astrophys. Lett.; 15: No. 2, 61-65(Oct 1973).

21-cm line absorption measurements in the direction of the supernova remnant IC443 suggest that it probably lies at a distance greater than 2.2 kpc and may be unassociated with an extended H II region to the east of the SNR. The remnant MSH11-61A is probably at a distance of about 3.5 kpc but the H II region MSH11-61B is probably unassociated, being considerably further from the Sun. (auth)

19221 PREDICTED PREFERENTIAL BACKWARD EMISSION AT THE SECOND HARMONIC OF THE PLASMA FREQUENCY IN SOLAR RADIO BURSTS. Melrose, D. B. (Australian National Univ., Canberra). Astrophys. Lett.; 15: No. 2, 55-57(Oct 1973).

Theories which predict a preferential backward emission at the second harmonic in solar radio bursts of spectral Types II and III are outdated. The simplest acceptable theory predicts only forward emission, i.e., no emission in the backward hemisphere. Alternative explanations should be sought for those observations presently interpreted in terms of a preferential backward emission. (auth)

19222 DIFFUSIVE FRACTIONATION OF SURFACE IMPLANTED GASES. Huneke, J. C. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 21: No. 1, 35-44(Dec 1973).

During the thermal release of gases trapped in near-surface regions, the composition of the evolving gas, as well as that of the remaining gas, asymptotically approaches a constant value different from the composition of the implanted gas and dependent on the relative depths of trapping and the relative diffusion coefficients. The composition of the implanted gas cannot be unambiguously determined by thermal release experiments, except if large losses have occurred simultaneously with ion implantation, in which case the composition of the implanted gas is the same as the observed composition of the initial gas release. If large gas losses occur subsequent to gas implantation but prior to analysis, all thermal release fractions will have the asymptotic composition. Thus, the observation of a constant composition for a large number or even all thermal release fractions representing a major portion of the total gas is not sufficient evidence for the existence of a gas reservoir in the solar system with that composition. Additional information about the extent of prior loss and about relative implantation depths and diffusion coefficients is necessary to deduce the composition of the implanted gas. Evidence that trapped rare gases in lunar samples and gas-rich meteorites are fractionated by this mechanism is found in the variation of the trapped Ne isotopic compositions as a function of gas release and the comparison of these compositions with solar wind values. At least two of the Ne components previously inferred to exist in these samples can be related by diffusive fractionation during analysis. (auth)

19223 TRAPPED SOLAR AND COSMOGENIC NOBLE GAS ABUNDANCES IN APOLLO 15 AND 16 DEEP DRILL SAMPLES. Bogard, D. D. (Johnson Space Center, Houston, TX); Nyquist, L. E.; Hirsch, W. C.; Moore, D. R. Earth Planet. Sci. Lett.; 21: No. 1, 52-69(Dec 1973).

Abundances and isotopic compositions of all the stable noble gases have been measured in 19 different depths of the Apollo 15 deep drill core, 7 different depths of the Apollo 16 deep drill core, and in several surface fines and breccias. All samples analyzed from both drill cores contain large concentrations of solar wind implanted gases, which demonstrates that even the deepest layers of both cores have experienced a lunar surface history. (WDM)

19224 STUDY OF PRECIOUS METAL DISTRIBUTION IN IRON METEORITES BY THE METHOD OF NEUTRON-ACTIVATION ANALYSIS. Sil'vanovich, Yu. A.; Rakhimov, Kh.; Ganiev, A. G.; Lavrukhina, A. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 10, 1577-1582(Oct 1973). (In Russian).

The concentration of precious metals varies in a wide interval of concentration. Seven of the analyzed meteorites were enriched in Ru, three in Pd, one in Os, and one in Pt which indicates the strong differentiation of this group of elements. A positive correlation was observed in the Ir–Os and Pt–Ru concentrations (Ir: Os and Pt: Ru = 1: 1) which is in agreement with the literature data for other meteorites. There is a tendency to a positive correlation of the Os–Ru and Ir–Ru concentrations. The ratio of the concentration of the latter series (with increase of the concentration) changes from 5 to 20. For four octahedrites, two hexahedrites, and Ching ataxite a negative correlation of the Ir–Pt concentration was observed. There is no correlation for the Ir–Pd concentration. Au has a tendency to negative correlation with Pt, Ir, Os, and Ru and a positive correlation with Pd. Increase of the concentration of Au with increase of the Pd concentration and the positive correlation of Au–Ni and Pd–Ni makes it possible to assign them to the Au–Pd–Ni group. (tr-auth)

19225 DAMPING AND NONLINEAR WAVE–PARTICLE INTERACTIONS OF ALFVEN WAVES IN THE SOLAR WIND. Lee, M. A.; Voelk, H. J. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Astrophys. Space Sci.; 24: No. 1, 31-49 (Sep 1973).

Since most Alfvén-waves in the solar wind are observed to come from the Sun, nonlinear wave-particle interactions can be expected to constitute their dominant dissipation process. The growth or damping of two circularly-polarized Alfvén-waves with wave vectors parallel to the ambient magnetic field is calculated using kinetic theory. If the waves are oppositely polarized they both damp proportional to their frequency. If the waves are of the same polarization, both the lower frequency wave and the plasma particles gain energy at the expense of the higher frequency wave. Thus, with increasing distance from the Sun, a steepening of the power spectrum is expected. For waves propagating in the same direction, the interaction is negligible for small β, while it becomes appreciable for $\beta \geq 10^{-1}$. For conditions typical of the solar wind near 1 AU an observed half-hour linearly-polarized wave, for example, with $\delta B = 0(B_0)$ has a damping time of about 10 h. (auth)

19226 ELECTRIC FIELD MICROFLUCTUATIONS ON THE SHOCK FRONT IN THE MODEL EXPERIMENT. Podgorni, I. M.; Andryanov, Y. V.; Dubinin, E. M. (Space Research Inst., Moscow). Astrophys. Space Sci.; 24: No. 1, 245-257(Sep 1973).

Fluctuations of the electric and magnetic field are studied in collisionless shock formed during plasma flow over a terrella. Spectra of magnetic fluctuations in the laboratory experiment and in space appear to coincide in dimensionless units. Electric field fluctuations appear at the shock wave formation, with frequencies in the hybrid Larmor frequency range. The appearance of noise is preceeded by the formation of positive potential maxima. The reflection of ions from the potential maxima must lead to two stream motion in a plasma with magnetized electrons. Such motion is unstable and excites longitudinal waves. Dissipation of energy of the directional motion after damping of electrical noises apparently occurs only through microfluctuations of the magnetic field. (auth)

19227 TWO-STREAM INSTABILITY IN A COLLISIONLESS PLASMA. Kathuria, S. N. (Weather Radar Unit, New Delhi); Kalra, G. L. Astrophys. Space Sci.; 24: No. 1, 133-143(Sep 1973).

This paper discusses the development of two-stream instability in a collisionless plasma. The plasma is described by velocity moments of Vlasov equation where heat flow tensor has been neglected. A dispersion relation for arbitrary propagation is derived for a collisionless electron fluid. Special cases of propagation parallel and perpendicular to the field lines are discussed. Growth rate is computed for parameters representative of the shear layers of solar wind at one AU. It is found that the shear layers are likely to be overstable. (auth)

19228 STRUCTURE OF WEAK SHOCK WAVE DISCONTINUITIES IN MAGNETOHYDRODYNAMICS. Selak, S. (Geomagnetic Inst., Grocka, Yugoslavia). Astrophys. Space Sci.; 24: No. 2, 309-321(Oct 1973).

The propagation of a weak shock wave in a medium of initially constant fluid velocity, magnetic field, and thermodynamic parameters was studied. The structure of discontinuities for such a shock in real cases was analyzed. By examining the change in variables inside the relaxation transition region, the length of the latter, i.e. of the disturbed region was obtained. In order to derive the physical model explaining the finite shock length, several assumptions were made: the medium was treated as a very large layer of nonnegligible viscosity and thermal conductivity. Starting from basic MHD relations, the invariants on the shock fronts, taking into consideration the process inside the disturbed region, were calculated. Modified Rankine–Hugoniot equation discussing the process inside the relaxation region was derived therefrom. Finally, the dependence of pressure upon distance was examined under the assumptions: the fluid was considered as polytropic. Hence, by approximate integration of an obtained transcendental function, the length of relaxation region was obtained and the result obtained is discussed. (auth)

19229 SOLAR GRANULATION, LIMB FLUX, AND OBLATENESS. Kandel, R. S.; Keil, S. L. (Boston Univ.). Solar Phys.; 33: No. 1, 3-21(1 Nov 1973).

The radiation field, emergent from an inhomogeneous atmosphere, may differ significantly from that calculated using a mean model for such an atmosphere. In the solar case, horizontal anisotropy of the granulation pattern leads to azimuthal dependence of the emergent intensity, and this appears as a latitude-dependent limb flux which may mimic oblateness. This latitude-dependence was examined for several two- and three-dimensional models of the inhomogeneous solar atmosphere, with varying degrees of anisotropy in the granulation pattern. Elongation along an east–west axis of about 7% would yield a signal somewhat imperfectly mimicking an excess oblateness of 4×10^{-5}. Using the Babcock–Leighton model of the general solar magnetic field it is shown that some stretching of granules, of this order of magnitude, should be expected. However, it may vary with the solar activity cycle, and in any case the result is very sensitive to the parameters adopted. Even if study of granulation observations should exclude elongations as high as 7%, smaller essentially undetectable elongations may exist. It is found that 1% elongation can account for 25 to 50% of a signal corresponding to excess oblateness 4×10^{-5}. It is concluded that anisotropy of the granulation pattern may influence oblateness determinations; when this is considered together with other effects, much of the claimed oblateness may be eliminated. (auth)

19230 OBSERVATION OF THE ABSOLUTE INTENSITY AND THE CENTER-TO-LIMB VARIATION OF THE SUN IN THE VACUUM ULTRAVIOLET REGION. Nishi, K. (Tokyo Astronomical Observatory, Mitaka, Japan). Solar Phys.; 33: No. 1, 23-31(1 Nov 1973).

The absolute intensities and the center-to-limb variations of the Sun at three wavelengths of 1629, 1684, and 1739 Å were measured by a rocket-borne spectrometer flown from the Kagoshima Space Center on September 1, 1971. The spectrometer was a double-dispersive trichrometer, whose spectral and spatial resolutions were 8.3 Å and 1.3′ respectively. The results concerning the absolute intensities were similar to those measured by the Harvard College Observatory group. The results for the center-to-limb variation at 1629 and 1684 Å seem to support the HSRA model but not those at 1739 Å. (auth)

19231 FLUCTUATIONS OF BRIGHTNESS AND VERTICAL VELOCITY AT VARIOUS HEIGHTS IN THE PHOTOSPHERE. Canfield, R. C.; Mehltretter, J. P. (Air Force Cambridge Research Labs., Sunspot, NM). Solar Phys.; 33: No. 1, 33-48 (1 Nov 1973).

In a spectrogram of exceptionally high spatial resolution, brightness and velocity fluctuations in seven weak to medium-strong Fe I lines were measured and analyzed. Heights of formation of these lines were computed using the Harvard–Smithsonian Reference Atmosphere (Gingerich et al., 1972), taking into account departures from LTE. The results show that granular velocity fluctuations decrease with increasing height up to the vicinity of the temperature minimum. If extrapolated downward to the height of formation of the continuum, the rms velocity fluctuation is 0.8 km s^{-1} with an estimated error of ± 0.2 km s^{-1}. The correlation of continuum brightness fluctuations with velocity fluctuations decreases rapidly with height, and even becomes slightly negative at h > 160 km. This finding is consistent with the picture of the granulation consisting of convective elements overshooting into a stable atmosphere. (auth)

19232 TEMPERATURE VARIATIONS IN THE SOLAR PHOTOSPHERE. I. Temperature Sensitivity of Some Fraunhofer Lines. Caccin, B.; Donati-Falchi, A.; Falciani, R. (Capodimonte Astronomical Observatory, Naples). Solar Phys.; 33: No. 1, 49-57(1 Nov 1973).

Detailed LTE calculations were made of the sensitivities of some Fraunhofer lines to local variations of the effective temperature of the Sun, taking also into account the effects of local variations of the microturbulence. The temperature sensitivities show a clear dependence upon the mean optical depth at which lines originate and upon the binding energy of the lower level involved in the transition. A list of some selected lines is given, in view of possible measurements either of any pole equator-variation of the effective temperature or of such local effects as those connected with the presence of strong nonspot magnetic fields. (auth)

19233 LIMB EMISSION LINES NEAR SOLAR H AND K: λλ 3900 TO 4000 A. Stencel, R. E. (Univ. of Michigan, Lake Angelus). Solar Phys.; 33: No. 1, 59-62(1 Nov 1973).

Nineteen calibrated spectrum plates, each containing up to six spectra at various limb distances, were secured at McMath–Hulbert observatory. On microdensitometer tracings, the emission lines were measured relative to nearby unblended Fraunhofer lines. (WDM)

19234 CHROMOSPHERIC TEMPERATURE INVERSION AND ITS IMPLICATIONS ON MILLIMETER BRIGHTNESS DISTRIBUTION. Neidig, D. F. Jr. (Alliance Coll., Cambridge Springs, PA). Solar Phys.; 33: No. 1, 63-67(1 Nov 1973).

The brightness temperature curve of the quiet Sun at millimeter wavelengths suggests a possible inversion in the mid-millimeter range. Interpreting this as a result of an actual inversion in the chromospheric temperature structure, and example of a model chromosphere is presented whose calculated temperature curve exhibits such an inversion. This model is then tested for radial brightness distribution at millimeter wavelengths. Comparing the calculated distributions at 3.2 mm and 6 mm with eclipse measurements made with parabolic cylinders at 3.2 mm and 8.6 mm shows qualitative agreement, allowing for instrumental smoothing. It is concluded that a chromospheric temperature inversion, either actual or effective, could account for the inversion suggested by millimeter data and also the complex brightness distributions measured during eclipses with parabolic cylinders. (auth)

19235 MICROWAVE OBSERVATIONS OF THE JANUARY 4, 1973 SOLAR ECLIPSE. Kaufmann, P.; Scalise, E. Jr.; Marques dos Santos, P.; Schaal, R. E.; Fortunato, R. A. A. (Univ. Mackenzie, Sao Paulo, Brazil). Solar Phys.; 33: No. 1, 69-73 (1 Nov 1973).

The eclipse was observed at two microwave frequencies, 7 GHz and 22.2 GHz, and showed the presence of polarized regions, suggesting also excess of left-handed polarized radiation from the solar northern hemisphere. Difference in eclipsing times at the two frequencies for an active center near the limb is discussed. (auth)

19236 LATITUDE AND SOLAR-CYCLE DEPENDENCE OF THE HEIGHT OF 9.1 CM RADIO EMISSION. Graf, W.; Bracewell, R. N. (Stanford Univ., CA). Solar Phys.; 33: No. 1, 75-85(1 Nov 1973).

The apparent height of radio sources above the photosphere was determined for the period of 1968–1971, by a method which makes use of the displacement in latitude of the centroid of the radio emission relative to the associated optical feature. The apparent height fell progressively in time by amounts that would not have been noticeable in earlier observations. Furthermore, in any given year the height was found to depend on latitude, being larger at low latitudes. It remains to be seen to what extent these variations represent real changes in height and to what extent they are apparent. In either case, modification of solar atmospheric models will be required to account for these previously unreported phenomena. (auth)

19237 MODULATIONS OF TRAPPED OSCILLATIONS IN THE SOLAR CHROMOSPHERE BY MAGNETIC FIELDS. Nakagawa, Y. (High Altitude Observatory, Boulder, CO). Solar Phys.; 33: No. 1, 87-101(1 Nov 1973).

Observations indicate modulations of the 5-min period of chromospheric oscillations in magnetically active regions of the Sun. The observations are examined on the basis of the diagnostic diagrams obtained previously in a theoretical study of trapped magnetoatmospheric waves, and it is shown that the observed results can be interpreted in terms of the modulations of characteristic period of the trapped magnetoatmospheric waves for various configurations and strengths of the magnetic field, such as the umbra and penumbra of a sunspot, plages, boundaries as well as inside of supergranulation cells. The physical significance of the results and the limitation of the present analysis are discussed together with the possible future direction of this type of study. (auth)

19238 NOTE ON THE RESPONSE OF AN ATMOSPHERE TO A LOCALIZED TURBULENT SOURCE. Provost, J. (Observatoire de Nice). Solar Phys.; 33: No. 1, 103-105(1 Nov 1973).

The question whether some eigen-modes resulting from a linear analysis should be favored or eliminated in the solar atmosphere has been discussed in the literature on the basis of the following argument: the "most easily excited" modes are those whose energy is concentrated in the region where excitation occurs. In the Sun, the excitation of the atmosphere is due to the turbulence in the upper part of the convective zone where one finds the highest eddy-velocities. Jones (1969) uses this argument to favor divergence-free oscillations with a period between 200 and 400 s, considering that the maximum of their energy is reached in the presumed excitation region. Leibacher (1971) similarly considers that modes having their maximum amplitudes outside the region of excitation are unlikely to be excited. This argument is discussed by considering the linear response of a stratified atmosphere to a source S(z, t) concentrated in space. (WDM)

19239 COMPUTATION AND OBSERVATION OF ZEEMAN MULTIPLET POLARIZATION IN FRAUNHOFER LINES. I. Photographic Measurement of Stokes Parameters. Wittmann, A. (Univ. Sternwarte, Goettingen, Ger.). Solar Phys.; 33: No. 1, 107-118(Nov 1973).

A brief introduction to the concept of Stokes parameters and their application to solar magnetic field measurements is followed by the description of a new photographic polarimeter which is capable of measuring profiles of all Stokes parameters simultaneously. Its performance characteristics and the method of measuring and correcting instrumental polarization are discussed. (auth)

19240 LIFETIMES OF ENHANCED CHROMOSPHERIC NETWORK FEATURES NEAR ACTIVE REGIONS. Prata, S. W. (Hale Observatories, Pasadena, CA). Solar Phys.; 33: No. 1, 119-130(1 Nov 1973).

Centerline Hα filtergrams providing nearly full day coverage of the Sun are used to study the lifetimes of enhanced network features near active regions. In the two cases studied the fraction remaining of those features present at an original epoch remains near unity for 50 h, then drops exponentially with a 1/e decay time of 30 h. Histories of representative enhanced network features are discussed. (auth)

19241 CHARACTERISTICS OF THE BASIC FRAMEWORK OF SOLAR ACTIVE REGIONS AND THE MAGNETOHYDRODYNAMICAL STRUCTURE OF THE CONVECTION ZONE. Yoshimura, H. (Tokyo Univ.). Solar Phys.; 33: No. 1, 131-143(1 Nov 1973).

The characteristics of the basic framework of structure and development of solar active regions are interpreted as good indicators of the magnetohydrodynamical structure of the convection zone, the magnetic field lines of which are twisted and are made wave-like by the action of the very large scale nonaxisymmetric convection, called here the global convection. The characteristics discussed in this paper are: (i) the preponderance of preceding spots of bipolar sunspot groups in strength and lifetime relative to the following spots of the groups, (ii) the tilt of bipolar axes of the sunspot groups to the local parallels of latitude, (iii) the forward inclination of normal axes of sunspots inferred from the east–west asymmetry of the appearance and total area of sunspots, (iv) the faster rotation of sunspots than the averaged fluid rotation, and (v) the association of the characteristics of an active region with the presence of an older active region in its vicinity and with the relative disposition of the two active regions. (auth)

19242 CORONAL PROMINENCES ON THE DISK OBSERVED ON OCTOBER 29, 1972. Kawaguchi, I.; Kitai, R. (Kyoto Univ.). Solar Phys.; 33: No. 1, 145-152(1 Nov 1973).

A group of coronal prominences appeared over a large sunspot group near the central meridian on October 29, 1972. The bright points, which were most clearly seen on the Hα-image taken at the line center, are interpreted as the points of inflow of the prominence matter into the penumbra. The amount of mass transported by the largest prominence among the group is found to share a considerable fraction of the total mass which may be contained in the permanent coronal condensation over the spot group. The observational data for the microwave emission from the spot group is discussed in relation to this phenomenon. (auth)

19243 INTERFEROMETRIC INVESTIGATION OF EMISSION LINES FROM THE SOLAR CORONA. Marshall, P. M.; Henderson, G. (Heriot-Watt Univ., Edinburgh). Solar Phys.; 33: No. 1, 153-168(1 Nov 1973).

The profiles of the Fe XIV, λ5303, and Fe X, λ6374, emission lines of the solar corona were observed at different positions using a photoelectric scanning Fabry–Perot interferometer. These profiles were obtained during the eclipse of 7th March 1970, in Mexico and at the Pic-du-Midi coronagraph in October, 1970. The half-widths of these profiles were determined for both the coronal lines and temperatures were derived from these widths. No systematic temperature variation was discovered, however there was some suggestion of the existence of a fluctuation with time in the width of the emission lines. (auth)

19244 POLARIZATION OF THE SOLAR CORONAL EMISSION LINES. Mogilevskii, E.; Ioshpa, B.; Obridko, V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Moscow). Solar Phys.; 33: No. 1, 169-175(1 Nov 1973).

The results of the spectrophotometrical measurements of the polarization in the coronal lines Fe XIV 5303 Å and Fe X 6374 Å are given. Polarization spectrograms were obtained by two spectrographs (prism and echelle types) during the solar eclipse in Mexico on March 7, 1970 near the region of the second contact at the heights 0.06 to 0.12 $R_\odot$ above the limb. The polarization in the green line was about 30% (for averaged height 1.08$R_\odot$). The polarization in the red line was close to the errors of the measurement and did not exceed 6%. A brief discussion of the results is given. (auth)

19245 ASSOCIATION OF SOLAR PROMINENCES AND CORONAL MAGNETIC SHEETS FROM THEIR OBSERVED CORRELATION WITH TYPE III RADIOBURSTS. Mercier, C. (Meudon Observatory, France). Solar Phys.; 33: No. 1, 177-186(1 Nov 1973).

It is shown that coronal structures in which are excited Type III bursts (observed with the Nancay radioheliograph) have a good correlation with existence of plage filaments. By accepting that Type III bursts reveal the presence of coronal magnetic neutral sheets, an interpretation of results is proposed and discussed in relation with theories of formation of filaments from coronal neutral sheets. It is suggested that the delay of one day observed in several cases between the Type III burst occurrence and the filament appearance may be of the order of the filament condensation time from the neutral sheet. (auth)

19246 FORCE-FREE MAGNETIC FIELDS AND FLARES OF AUGUST 1972. Tanaka, K.; Nakagawa, Y. (High Altitude Observatory, Boulder, CO). Solar Phys.; 33: No. 1, 187-204(1 Nov 1973).

On the basis of observations (Zirin and Tanaka, 1973) inferring the presence of shear in magnetic fields, the amount of extractable energy stored in a class of force-free magnetic fields is evaluated for the flares of August 1972, using the formulations developed by Nakagawa and Raadu (1972). It is shown that the evaluated energy storage could be built up by the proper motions of sunspots in the active region McMath 11976 during July 31 and August 7. Then for the flare of August 7, a detailed analysis is made of the manner of energy release in the post maximum phases deduced from the configuration of flare loops. It is shown that the observed flare loops could be represented closely by the force-free magnetic fields and that the evaluated rate of energy release is consistent with observed rate given by the soft x-ray emission. The results of analysis suggest that the flare of August 1972 could be identified with the relaxation of an energetic force-free magnetic field towards lower energy states. The limitations and possible future extension of this type of analysis are discussed. (auth)

19247 ANALYSIS OF THE AUGUST 7, 1972 WHITE LIGHT FLARE: CHANGES IN THE MAGNETIC AND VELOCITY FIELDS. Rust, D. M. (Sacramento Peak Observatory, Sunspot, NM). Solar Phys.; 33: No. 1, 205-212(1 Nov 1973).

Measurements with the Doppler–Zeeman analyzer reveal redshifts and decreasing magnetic fields in the photosphere immediately below the center of the August 7, 1972 proton flare. These observations are combined with spectra and photographs of sun-

spot developments in the region to produce a consistent picture of fluctuations in orientation and strength in the fields of three spots intimately connected with the flare. Before the flare, the photosphere appears to experience an upheaval of material frozen into rising lines of magnetic force. After the start of the flare and through the following 4 h, the motion is downward. (auth)

19248 TOWARDS A BETTER DYNAMIC THEORY FOR TYPE III RADIO BURSTS. Smith, D. F. (High Altitude Observatory, Boulder, CO). Solar Phys.; 33: No. 1, 213-223(1 Nov 1973).

An approximate numerical solution is given to the quasilinear equations governing the interaction of the electron streams exciting Type III solar radio bursts and the background plasma. The density and temperature variations are taken into account and the stream is studied from r = 1 to 20 $R_\odot$. The method used is to level any positive slopes in the distribution function as they develop and record the energy released. None of the energy released is allowed to return to the stream and since no other damping mechanisms are taken into account, the solution is only applicable to the initial rise of the burst. Even then, the solution gives more deceleration of the leading edge of the burst than observed which indicates that letting some of the energy released return to the stream is necessary. At the same time the solution does show that depletion of high velocity electrons is an important process and calls into question any analysis which neglects this process by, for example, integrating over the spectrum of plasma waves such as Zaitsev et al. (1972). It is shown that the case considered here is an opposite limiting case to the one considered by Zaitsev et al. and what needs to be done to find the more realistic solution in between these two limiting cases is indicated. (auth)

19249 NONLINEAR WAVE COUPLING IN TYPE IV SOLAR RADIO BURSTS. Chiuderi, C. (Osservatorio di Arcetri, Florence); Giachetti, R.; Rosenberg, H. Solar Phys.; 33: No. 1, 225-238(1 Nov 1973).

In order to explain a fine structure of parallel ridges in stationary Type IV continua, the emission due to the coupling of electrostatic upper hybrid waves and Bernstein waves at the sum frequency of the upper hybrid and harmonics of the gyro frequency was calculated. If the energy density of these electrostatic waves is of the order of 10^{-3} times the thermal energy density, then the observed zebra pattern can be emitted by a region with a diameter of $\sim 10^9$ km. (auth)

19250 REPLY TO "SHOCK WAVE EFFECTS IN SOLAR COSMIC RAY EVENTS" BY I. D. PALMER. Kahler, S. W. (American Science and Engineering, Cambridge, MA). Solar Phys.; 33: No. 1, 239-240(1 Nov 1973).

Recently, Palmer (1972) discussed two low-energy ($E \leq 1$ MeV) solar proton events which displayed a gradual intensity increase to a maximum near the time of an SSC followed by a large abrupt decrease. His interpretation used a model in which a population of cosmic rays is swept ahead of an interplanetary shock wave. Palmer's introductory statements concerning a model for the same phenomena published earlier (Kahler, 1969) are considered. (WDM)

19251 LARGE-SCALE STRUCTURE OF THE INTERPLANETARY MEDIUM. I. High Coronal Source Longitude of the Quiet-Time Solar Wind. Nolte, J. T.; Roelof, E. C. (Univ. of New Hampshire, Durham). Solar Phys.; 33: No. 1, 241-257(1 Nov 1973).

It is proposed that the coronal source longitude and latitude of solar-wind plasma can be estimated within $\sim 10°$. Previous writers have argued that the solar wind in the ecliptic should originate near the equator and that a quasi-radial hypervelocity (QRH) approximation (constant radial flow) is valid beyond the magnetohydrodynamic critical points. It is demonstrated that an extension of the QRH approximation (as if the solar wind flowed radially with constant velocity from the center of the Sun) yields a proper estimate of the high coronal source location at the "release zone" where the solar wind makes its transition to radial interplanetary flow. This "extrapolated" QRH (or EQRH) approximation succeeds because the two main corrections to this source estimate, coronal corotation and interplanetary acceleration, tend to cancel (the former correcting the source location eastward, the latter westward). Although this "ideal spiral" approximation was first suggested by Snyder and Neugebauer (1966), only recently has it been demonstrated that it relates a wide range of interplanetary plasma, magnetic field, and energetic particle data to observed coronal magnetic structure. The error in the EQRH approximation is estimated by comparison with steady-state streamlines predicted by azimuthally independent and dependent theoretical solutions to the steady-state plasma equations. The error in both cases $\leq 10°$ in longitude and it is therefore suggested that the EQRH approximation offers the means to relate observed solar "initial conditions" in the "release zone" directly to interplanetary measurements. If, in addition, the EQRH approximation also leads to agreement with low coronal structure, then there should be a straightforward correspondence to otherwise unobservable high coronal structure. (auth)

19252 OXYGEN ISOTOPE COSMOTHERMOMETER REVISITED. Onuma, N. (Tokyo Gakugei Univ., Koganei, Japan); Clayton, R. N.; Mayeda, T. K. Geochim. Cosmochim. Acta; 38: No. 1, 189-191(Jan 1974).

A previously published estimate (Onuma et al., Geochim. Cosmochim. Acta.; 36: 169 to 188 (1972)) of the oxygen isotopic composition of the gas of the early solar nebula must be revised in light of the discovery of nonchemical isotope effects in carbonaceous chondrites. The solids which accreted to form the Earth, Moon, and ordinary chondrites probably did not equilibrate isotopically with the gas below 1000 K. (auth)

19253 INFORMATION CONTENT OF IONOSPHERIC SOLAR FLARE EFFECT OBSERVATIONS. II. Some Model Considerations on the Interpretation of Solar Flare Effects in the Ionosphere. Taubenheim, J.; Entzian, G.; Knuth, R.; Ohle, K. H. (Deutsche Akademie der Wissenschaften, Berlin). J. Atmos. Terrest. Phys.; 36: No. 3, 525-535(Mar 1974).

Analysis of records of LF sudden field anomaly (SFA) effects, together with the SOLRAD-9 records of the corresponding solar x-ray flare, shows that the quasi-phase height interpretation of the SFA effects is justified and that relatively simple model assumptions are able to provide a quantitative interpretation of these effects and their dependence on solar zenith angle as described in Part I of this paper (Ohle et al. 1973). The good internal consistency of the model permits the following conclusions: (a) The LF quasi-phase height corresponds, in first approximation, to a level of constant electron density, (b) the effective loss coefficient below 85 km is proportional to air density, (c) the NO concentrations below 85 km are certainly not less than the values given by Meira (J. Geophys. Res.; 76:202 (1971)). (auth)

19254 INFORMATION CONTENT OF IONOSPHERIC SOLAR FLARE EFFECT OBSERVATIONS. I. Experimental Evidence of Solar and Atmospheric Control of the Flare Effects. Ohle, K. H.; Knuth, R.; Entzian, G.; Taubenheim, J. (Deutsche Akademie der Wissenschaften, Berlin). J. Atmos. Terrest. Phys.; 36: No. 3, 513-524(Mar 1974).

On the basis of different SID-observations in central Europe in the years 1969 and 1970, with special emphasis on the extremely strong flare period in June 1970, the combination of satellite x-ray observations with ionospheric observations and the problem of the respective "efficiencies" of the different kinds of ionospheric SID recordings (SFA, SEA, SSWF, and SCNA) have been investigated. It could be concluded, that the response of the lower ionosphere to solar flare x rays depends strongly on season and solar zenith angle χ. Therefore a general estimation of x-ray fluxes from SID records (especially from their "importances" alone) can be very doubtful and seems possible only for strongly limited cases. The principally most efficient method for monitoring and investigating solar flare effects in the lower ionosphere seems to be the LF field-strength observation (SFA) interpreted by quasi-phase heights. Gross calculations of the scale heights between 69 and 78 km, on the basis of SFA-observations, are in general accordance with the Mean CIRA 1965-model. An upper limit for the electron production by x-ray flares in summer has been estimated. The ionospheric flare layer is 2 to 3 times thicker in winter than in summer. Also the time delay between x-ray flare maximum and SFA-maximum is slightly but significantly shorter in winter than in summer, indicating that the mesosphere reacts faster and more sensitively in winter. Comparisons between SFA and SSWF indicate "sensitive heights" above about 80 km for SSWF and below 80 km for SFA. The time-sequence of the effects in different heights, during the initial phase, can be characterized in terms of a gradually down-coming SID layer. (auth)

19255 INTERPLANETARY SECTOR STRUCTURE AND THE HELIOMAGNETIC EQUATOR. Schulz, M. (Aerospace Corp., El Segundo, CA). Astrophys. Space Sci.; 24: No. 2, 371-383 (Oct 1973).

The magnetohydrodynamics of solar-wind flow lead logically to the formation of one warped annular neutral surface that apparently extends from ~ 2 $R_\odot$ to the boundary of the heliosphere. The most likely asymptotic configuration for this neutral sheet intersects the heliomagnetic equatorial plane along four corotating arcs. The observer sees a reversal of magnetic polarity on each crossing of the neutral surface, and so interprets each reversal as the crossing of a sector boundary. (auth)

19256 FURTHER COMMENTS ON APPROXIMATIONS OF THE RADIAL DEPENDENCE OF THE ELECTRON TEMPERATURE IN TWO-FLUID MODELS OF THE SOLAR WIND. Weber, E. J. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. Space Sci.; 24: No. 2, 595-597(Oct 1973).

In a previous paper (Cosmic Electrodyn. 3, 116) the use of the radial $r^{-\frac{1}{2}}$ dependence was suggested rather than the often used $r^{-\frac{1}{3}}$ one in approximations of the electronic temperature profile in some two-fluid models. This note is intended to clarify and restate some points on this subject. (auth)

19257 COMMENTS ON A NOTE PUBLISHED IN COSMIC ELECTRODYNAMICS. Dahlberg, E. (Royal Inst. of Tech., Stockholm). Astrophys. Space Sci.; 24: No. 2, 593-594(Oct 1973).

Brief comments are offered on the recent research note on radial dependence of electron temperature in two-fluid models of the solar wind by Weber (Cosmic Electrodyn. 3, 116). (WDM)

19258 SOLAR WIND HEATING BEYOND 1 AU. Holzer, T. E. (National Oceanic and Atmospheric Administration, Boulder, CO); Leer, E. Astrophys. Space Sci.; 24: No. 2, 335-347 (Oct 1973).

The effect of an interplanetary atomic hydrogen gas on solar wind proton, electron, and α-particle temperatures beyond 1 AU is considered. It is shown that the proton temperature (and probably also the α-particle temperature) reaches a minimum between 2 AU and 4 AU, depending on values chosen for solar wind and interstellar gas parameters. Heating of the electron gas depends primarily on the thermal coupling of the protons and electrons. For strong coupling (when $T_p \gtrsim T_e$), the electron temperature reaches a minimum between 4 AU and 8 AU, but for weak coupling (Coulomb collisions only), the electron temperature continues to decrease throughout the inner solar system. A spacecraft travelling to Jupiter should be able to observe the heating effect of the solar wind–interplanetary hydrogen interaction, and from such observations it may be possible to infer some properties of the interstellar neutral gas. (auth)

19259 DYNAMO THEORIES OF THE SOLAR AND GALACTIC MAGNETIC FIELDS. Piddington, J. H. (CSIRO, Sydney). Astrophys. Space Sci.; 24: No. 1, 259-267(Sep 1973).

Earlier criticisms of solar and galactic dynamo theories are extended to answer Parker's rebuttal, and the major modification made to his models to include Sweet's magnetic field annihilation mechanism as invoked in some theories of solar flares. His kinematic and weak-field analyses appear irrelevant because they ignore magnetic stresses which are of major importance and whose effects are evident in sunspots and elsewhere. It is shown that, even if Sweet's mechanism is effective under the most favorable conditions, these conditions are most unlikely in the solar convection zone or galactic disk. The problem is resolved by observational data which show that the fields are not tangled down to the scales required for dissipation by any known mechanism in the times available. Spot groups and many other patterns show that the solar fields are much too ordered to be products of a region of turbulence or to be dissipated by turbulence; the toroidal field must leave the Sun entirely to complete each 11-yr cycle. Faraday rotation, H I gas observations, and extragalactic fields provide strong evidence against a galactic dynamo and for a primordial field. (auth)

19260 IZMERENIE MAGNITNYKH POLEI I PLAZMY NA KOSMICHESKIKH APPARATAKH. (Measurement of Magnetic Fields and Plasmas in Cosmic Devices). Kovalevskii, I. V. Moscow; Izdatel'stvo Nauka (1973). 271p.

A summary and interpretation is given of the results of the direct measurement of magnetic fields and plasmas, performed on cosmic devices in interplanetary space, in the Earth's magnetosphere, in the region of the interaction of solar plasma currents with geomagnetic fields, and in the vicinity of the Moon and Venus. Data published up to 1967 are included. Launch data, orbit parameters, the effective life time, instrumentation (magnetometric apparatus and plasma probes), the basic results of the investigation, and their interpretation are given for each device. (tr-auth)

19261 INTERACTION OF INTERPLANETARY MHD SHOCK WAVES WITH THE MAGNETOPAUSE. Shen, W. W. (Texas Instruments Inc., Dallas). Astrophys. Space Sci.; 24: No. 1, 51-64(Sep 1973).

The interaction between a shock-wave and the magnetopause is formulated on the basis of one-dimensional magnetohydrodynamics. The magnetopause is assumed to be a tangential discontinuity, and the magnetic field is limited to the case of perpendicularity. Both the forward and reverse shocks' impact on the magnetopause are considered and analyzed separately. The forward shock–magnetopause interaction results in a transmitted shock, a tangential discontinuity, and a simple rarefaction wave. The reverse shock–magnetopause interaction creates a transmitted shock, a tangential discontinuity, and a reflected wave. The propagation of an SSC signal which is related to an interplanetary shock-induced geomagnetic storm's onset-time on Earth is discussed in general terms. It was found in earlier work (Shen and Dryer, 1972) that the propagation velocity of an interplanetary shock is decreased by about 10 ~15% following its impact with the Earth's bow shock; the present study shows that its velocity is then suddenly increased by a factor of two to three after impact with the magnetopause. The fast propagating shock-wave inside the magnetosphere degenerates into a hydromagnetic wave as it advances into an increasing intensity of the distorted dipole geomagnetic field. (auth)

19262 REVIEW OF THE CRITICAL VELOCITY OF GAS–PLASMA INTERACTION. I. Experimental Observations. Danielsson, L. (Royal Inst. of Tech., Stockholm). Astrophys. Space Sci.; 24: No. 2, 459-485(Oct 1973).

A review is given of the experimental investigations concerning the critical velocity of the interaction between a neutral gas and a plasma in relative motion. In most of the experiments this critical velocity is equivalent to a voltage limitation of a discharge through a partially ionized, magnetized plasma. The critical velocity phenomenon can have been of importance in a large number of experiments but it has been observed in rather few cases and studied in detail in less than half a dozen plasma machines. The major investigations were made in rotating plasma devices like the Homopolar, plasma guns, and a plasma–neutral gas impact experiment. The emphasis of this paper is concentrated, though not limited, to collision-free plasmas. Thus the (MPD-)arc experiments are not extensively treated. It is concluded that the existence, under certain conditions, of a critical velocity, critical voltage, or critical E/B (depending on the particular observation) is proved by sufficient experimental evidence. (auth)

19263 REVIEW OF THE CRITICAL VELOCITY OF GAS–PLASMA INTERACTION. II. Theory. Sherman, J. C. (Royal Inst. of Tech., Stockholm). Astrophys. Space Sci.; 24: No. 2, 487-510(Oct 1973).

The theories that have been proposed either as general justifications of Alfvén's critical velocity hypothesis or as explanations of critical velocity experiments are reviewed. Experimental investigations of the critical velocity phenomenon have been covered in a companion paper by Danielsson. (auth)

Galaxies

Refer also to abstracts 19091 and 19259.

19264 OBSERVATIONS OF THE BRIGHT RIM OF THE HORSEHEAD NEBULA IN Hα AND [N II]. Louise, R.; Sapin, C. (Observatory, Marseille). Astrophys. Lett.; 14: No. 2, 119-122(Jun 1973).

The "Horsehead" nebula was photographed with narrow interference filters centered respectively on Hα and [N II] (λ = 6584 Å). The [N II]/Hα ratio was deduced and its variation towards the bright rim of the Horsehead was studied. It is shown that the maximum value of the temperature is not reached on the rim itself but in a narrow zone located just behind it and ahead of the dark matter. (auth)

19265 ORTHO–PARA TRANSITIONS IN H_2 AND FRACTIONATION OF HD. Dalgarno, A.; Black, J. H.; Weisheit, J. C. (Harvard Coll., Cambridge, MA). Astrophys. Lett.; 14: No. 2, 77-79 (Jun 1973).

The otherwise nearly independent forms of H_2, ortho- and parahydrogen, can be mixed efficiently by rapid proton interchange collisions in interstellar clouds. Similar processes involving deuteron–proton interchange may dominate the fractionation of deuterium in HD and DCN. (auth)

19266 RADIO RECOMBINATION LINES FROM H I REGIONS. Brocklehurst, M. (University Coll., London). Astrophys. Lett.; 14: No. 2, 81-84(Jun 1973).

Level populations of hydrogenic ions in conditions typical of H I regions were obtained. The effects of a thermal continuum, as produced by a nearby H^+ region, were included. At very low electron densities this continuum dominates electron collisions and the calculations are density independent. (auth)

19267 RESPONSE OF A GRAVITATIONAL RADIATION DETECTOR TO MAGNETIC FIELD FLUCTUATIONS. Weber, J. (Univ. of Maryland, College Park); Trimble, V. Phys. Lett.; 45A: No. 5, 353-354(22 Oct 1973).

An attempt was made to measure the sensitivity of the Maryland gravitational radiation detector to fluctuating magnetic fields with

frequencies of 0.1 to 30 Hertz. No response was found for fields along the cylinder axis and normal to it. For some of the tests, the weakest intensity to which any part of the cylinder was exposed exceeded 100 times the intensity of fluctuations of the Earth's magnetic field at these frequencies. (auth)

19268 GENERATION AND DISSIPATION OF SOLAR AND GALACTIC MAGNETIC FIELDS. Parker, E. N. (Univ. of Chicago). Astrophys. Space Sci.; 22: No. 2, 279-291(Jun 1973).

Turbulent diffusion of magnetic field plays an essential role in the generation of magnetic field in most astrophysical bodies. This paper reviews what can be proved, and what can be believed, about the turbulent diffusion of magnetic field. Observations indicate the dissipation of magnetic field at rates that can be understood only in terms of turbulent diffusion. Theory shows that a large-scale weak magnetic field diffuses in a turbulent flow in the same way that smoke is mixed throughout the fluid by the turbulence. The small-scale fields (produced from the large-scale field by the turbulence) are limited in their growth by reconnection of field lines at neutral points, so that the turbulent mixing of field and fluid is not halted by them. Altogether, it appears that the mixing of field and fluid in the observed turbulent motions in the Sun and in the Galaxy is unavoidable. Turbulent diffusion causes decay of the general solar fields in a decade or so, and of the galactic field in 10^8 to 10^9 yr. It is concluded that continual dynamo action is implied by the observed existence of the fields. (auth)

19269 ACCRETION AND ELECTROSTATIC INTERACTION OF INTERSTELLAR DUST GRAINS; INTERSTELLAR GRIT. Wesson, P. S. (St John's Coll., Cambridge, Eng.). Astrophys. Space Sci.; 23: No. 1, 227-255(Jul 1973).

This work aims to elucidate the accretion mechanism, which operates via image-theory forces, whenever two interstellar dust grains come close together. (WDM)

19270 FLUCTUATIONS IN INTERSTELLAR GRAIN TEMPERATURES. Duley, W. W. (York Univ., Toronto). Astrophys. Space Sci.; 23: No. 1, 43-50(Jul 1973).

An analysis has been made of temperature fluctuations expected for various grain materials exposed to the interstellar radiation field. It is shown that in all but the densest clouds average grain temperatures in the 5 to 10 K range are of little statistical significance because of large fluctuations produced by absorbed photons from the interstellar radiation field. At higher average temperatures large fluctuations may still be present for certain grain materials and grain radii. The effect of these fluctuations on the simple problem of H atom recombination on grain surfaces is discussed. (auth)

19271 GRAVITATIONAL FIELD OF THREE DIMENSIONAL GALAXIES. Clutton-Brock, M. (Univ. of Newcastle Upon Tyne, Eng.). Astrophys. Space Sci.; 23: No. 1, 55-69(Jul 1973).

The simplest method of calculating gravitational fields is to use a set of biorthogonal pairs of mass-potential functions. A suitable set of functions for three dimensional mass distributions is derived which uses ultraspherical polynomials. Algorithms for computing the gravitational field are discussed which attempt to maximize computational efficiency. (auth)

19272 MODELS OF GALACTIC MASS DISTRIBUTION. Innanen, K. A. (York Univ., Toronto). Astrophys. Space Sci.; 22: No. 2, 393-411(Jun 1973).

Three groups of galactic mass models, each consisting of nine inhomogeneous spheroids of two kinds are described, according to three adopted values of the total density near the Sun: 0.10, 0.15, and 0.20 $M_\odot$ pc^{-3}. Approximately 20% of the total mass of each model is in the halo, constructed to adequately fit recent RR Lyrae star observations. It is shown that the maxima found in the RR Lyrae star densities towards the galactic axis (Plaut, 1970) should not be interpreted as being associated with the galactic nucleus, but as the result of the greater decrease in density with increasing z over the increase in density as the galactic axis is approached. Even at the low galactic latitude of 5° (l = 0°), this effect causes a 0.5 kpc correction to the distance to the galactic center. A "basic" model for $\varpi_\odot$ = 10.0 kpc, $\theta_\odot$ = 252.5 km s^{-1}, $\rho_\odot$ = 0.15 $M_\odot$ pc^{-3} is first constructed, mainly to satisfy structural conditions near the Sun and in the halo. An attempt to optimize the basic model is made by scaling it so as to retain constant density and angular velocity near the Sun, and to best fit kinematic data, including the recent re-examination of the 21-cm data of Simonson and Mader (1972). No unknown matter is required in the models, in accordance with the results of Weistrop (1972b), and, as pointed out earlier (Innanen, 1966b) the faint M-stars must be in a highly flattened spheroid. The optimizing indicates that an adequate fit to kinematics can be achieved for $0.15 < \rho_\odot < 0.20$ $M_\odot$ pc^{-3}, $8.5 < \varpi_\odot < 9.5$ kpc, and $215 < \theta_\odot < 250$ km s^{-1}. More detailed results are tabulated for a "representative" model for which $\varpi_\odot$ = 9.0 kpc, $\theta_\odot$ = 229 km s^{-1} and $\rho_\odot$ = 0.15 $M_\odot$ pc^{-3}. Two new galactic density functions are discussed. (auth)

19273 SEARCH FOR RADIO PULSES FROM THE GALACTIC CENTRE. Dube, R.; Groth, E. J.; Rudnick, L.; Wilkinson, D. T. (Princeton Univ., NJ). Nature (London) Phys. Sci.; 245: No. 141, 17-18(10 Sep 1973).

The results of a search at 430 MHz are described, using the 140 ft. telescope at the National Radio Astronomy Observatory, Green Bank, W. Virginia. No evidence was found for pulses of extraterrestrial origin, within the limits and assumptions discussed. Details are given of the experimental procedure used. (UK)

19274 NEUTRAL HYDROGEN IN GALAXIES OF EARLY AND OTHER TYPES. Lewis, B. M.; Davies, R. D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 213-229(1973).

Neutral hydrogen measurements were made for 29 galaxies with the Mark I and Mark II telescopes. The galaxies were mainly early types, although four Seyferts and a group of peculiar and other interesting objects were included. Spectra of the more intense galaxies are shown. An interesting result is the large neutral hydrogen content of the early-type galaxies (de Vaucouleurs types −3 to +1) compared with the trend of neutral hydrogen contents indicated by the late-type galaxies. The importance of this result for theories of galactic evolution is stressed. The neutral hydrogen content and velocity spread of the Seyfert and peculiar galaxies are found to be consistent with their morphological types and appear to be unaffected by their optical peculiarities. (auth)

19275 RADIO RECOMBINATION LINE EMISSION FROM THE GALACTIC PLANE. Matthews, H. E.; Pedlar, A.; Davies, R. D. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 149-172(1973).

166α Radio recombination line measurements were made of the distributed electron gas along the galactic ridge with the Mark II radio telescope (beamwidth 31′ × 33′ arc). Spectra taken at 13 points distributed along the galactic ridge between l = −1°.0 and 47°.5 show that the bulk of the recombination line emission is confined to the region $l \lesssim 40°$ ($R \lesssim 7$ kpc). The electron temperature, T_e, is found to be 6000 ± 1000 K. This result contradicts the assertion by Gottesman & Gordon that $T_e \sim 10^3$ K. The recombination line and continuum emission originate in elongated H II complexes 3° to 5° in extent whose mean emission measure is 2700 cm^{-6} pc and rms electron density is 1.9 cm^{-3}. Their physical properties are similar to those of the low density H II regions NGC 2244, NGC 7000, and NGC 7822. It is shown that the density of the electron gas in the central regions of the Galaxy is substantially greater than in the spiral arm regions near the Sun. (auth)

19276 RECOMBINATION LINE EMISSION FROM THE GALACTIC CENTRE. Matthews, H. E.; Davies, R. D.; Pedlar, A. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 173-183(1973).

166α (1424; 734 MHz) hydrogen recombination line spectra were obtained at six positions in the galactic centre region. They indicate that the emission is from an extended region which, it is argued, lies at the centre of the Galaxy. Electron temperatures in the vicinity of 1.0×10^4 K were obtained at each point. The total amount of ionized gas within 1° of the galactic centre was found to be 5×10^5 solar masses. (auth)

19277 SMALL PERTURBATIONS IN FLAT GALAXIES. II. Time-Dependent Azimuthal Perturbations. Clutton-Brock, M. (Univ. of Newcastle Upon Tyne, Eng.). Astrophys. Space Sci.; 21: No. 1, 79-106(Mar 1973).

Methods of calculating the response of a flat galaxy of stars to a perturbation which can depend on time and on angle are described. The starting point is the response to a pulse: the response to any other time dependence can be found by convolution. A single orbit responds with growing oscillations at the resonant frequencies, so the Laplace transform of the orbital response has a set of double poles along the real frequency axis. The problem of finding the response of the system is the problem of integrating these poles over all orbits. A simple expression for the orbital response is found in terms of the derivatives of Hankel–Laguerre functions with respect to action–angle variables. These derivatives can be computed with the aid of the computationally convenient variables introduced in Paper I. The Laplace transform of the system response is expanded in a series of simple basis functions. The expansion coefficients are found as integrals over all orbits of the basis functions multiplied by the amplitudes of the orbital response at the resonant frequencies. The integrands are not singular, and the integration is straightforward. (auth)

19278 NEUTRAL HYDROGEN IN VIRGO CLUSTER GALAXIES. Davies, R. D.; Lewis, B. M. (Nuffield Radio Astronomy Labs.,

Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 231-244(1973).

Twenty-one centimetre wavelength measurements, using the Mark I and Mark II radio telescopes, were made of the neutral hydrogen content of 25 galaxies in the Virgo cluster. Spectra of some of the brighter galaxies are shown, and the neutral hydrogen parameters of each galaxy are given in tabular form. A comparison of the neutral hydrogen mass-to-luminosity ratio and the neutral hydrogen surface density for the Virgo cluster galaxies with field galaxies indicates that on average the cluster galaxies are deficient in neutral hydrogen by a factor of ~0.63. Calculations of galactic collision times suggest that collisions are likely to be responsible for the deficiency of gas in the Virgo cluster galaxies at the present epoch. (auth)

19279 RADIO GALAXY 3C66. Northover, K. J. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 369-379(1973).

The radio galaxy 3C 66 has been mapped at frequencies of 1.4, 2.7, and 5.0 GHz with the Cambridge One-Mile telescope and at 5.0 GHz with the 5-km telescope. The main source (3C 66B) consists of a compact central component less than 0.8 kpc in diameter, coincident with the nucleus of the galaxy, together with very extended regions of low brightness emission on each side. The most remarkable feature of the source is a narrow jet of emission, approximately 30 kpc in length, linking the galactic nucleus to one of the extended regions and consisting of a number of compact components, less than 1 kpc in diameter, superimposed on a weak continuous background. The structure of 3C 66B, which suggests that energy is continuously supplied by the nucleus to the outer components, has a simple interpretation in terms of the bubble model recently proposed for more powerful, double radio galaxies. A further source (3C 66A), less than 1.6″ in diameter, is probably unrelated to 3C 66B. (auth)

19280 H166α STUDIES OF THE ROSETTE AND NORTH AMERICA NEBULAE. Pedlar, A.; Matthews, H. E. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 381-391(1973).

This paper describes observations of two extended, low emission measure, galactic H II regions using the H 166 α radio recombination line (1424.734 MHz). Nine positions have been observed in W80 (the North American and Pelican nebulae) and five in W16 (the Rosette nebula). The data are consistent with local thermodynamic equilibrium (LTE) and yield mean electron temperatures of 6900 K for the former, and 7900 K for the latter. (auth)

19281 STABILITY OF THE M87 JET. Okoye, S. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 4, 393-402(1973).

It is shown that the available observational data do not permit a unique description of the stability conditions in the Eo (Hubble) galaxy M87 (NGC 4486) optical jet. Thus depending on the actual magnitudes of the temperature, mass density, and initial ejection velocities of the thermal gas component of the jet, the optical knots in the jet can be postulated to be stabilized either by their self-inertia or by the action of an external agency such as the ram pressure of the intragalactic medium. It is also suggested that the existence in the jet of collapsed objects with masses $\gtrsim 10^7 M_\odot$ cannot be ruled out entirely and may well provide the tidiest method of dealing with the stability and associated problems. Future observations, in search of thermal x rays and optical line radiation in the jet, should enable the precise confinement mechanism of the knots to be established. (auth)

19282 ROTATION CURVE AND MASS DISTRIBUTION IN M31. Emerson, D. T.; Baldwin, J. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 9P-13P(1973).

The existing evidence is reviewed, and new 21-cm H I data are presented, concerning the shape of the rotation curve both in the inner and the outer parts of M31. It is concluded that a substantially constant value for the mass-to-luminosity ratio as a function of radius both for the spheroidal and the exponential disk components of the distribution of luminosity is in good agreement with the observations. (auth)

19283 PRESENCE OF GRAPHITE IN THE INTERSTELLAR MEDIUM. Czyzak, S. J. (Ohio State Univ., Delaware); Santiago, J. J. Astrophys. Space Sci.; 23: No. 2, 443-458(Aug 1973).

The justification for the presence of graphite in the interstellar medium is examined. The conditions necessary for growth of graphite (single crystals) and other structurally disordered carbons are discussed. The effect of structural imperfections on the mechanical, thermal, electrical, magnetic, optic, and chemical properties is illustrated. From this information it is concluded that the existence of graphite (single crystals) in the interstellar medium is unlikely. While various forms of highly disordered carbon grains may exist, none would satisfy the physical properties necessary to explain both polarization and extinction simultaneously. (auth)

19284 HYDROMAGNETIC EQUILIBRIUM STRUCTURE OF GRAVITATING CYLINDERS. Talwar, S. P.; Gupta, A. K. (Univ. of Delhi). Astrophys. Space Sci.; 23: No. 2, 347-364(Aug 1973).

The equilibrium distribution of physical properties in static or uniformly rotating infinitely extended self-gravitating magnetized cylinders is studied taking the magnetic pressure to bear a constant ratio to the gas pressure at each point. The fluid is idealized either as a perfect gas, obeying polytropic or isothermal relation, or a degenerate gas at zero temperature. Numerical results obtained for the physical properties are tabulated and the graphs are drawn showing the run of density and mass per unit length with distance from the axis in each case. (auth)

19285 RADIO EMISSION FROM NORMAL SPIRAL GALAXIES. Tovmassian, H. M. (Byurakan Astrophysical Observatory, Erevan); Terzian, Y. Astrophys. Lett.; 15: No. 2, 97-99(Oct 1973).

Radio observations of normal spiral galaxies at a frequency of 430 MHz are presented. These observations were performed with the 1000-ft radio telescope at Arecibo. The relation between radio emission from normal spiral galaxies and evidence of nuclear activity is investigated and it is shown that a correlation exists. (auth)

19286 FORMATION OF CH IN INTERSTELLAR CLOUDS. Black, J. H.; Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. Lett.; 15: No. 2, 79-82(Oct 1973).

It is suggested that CH is produced in interstellar clouds by sequences of reactions initiated by $C^+ + H_2 \rightarrow CH_2^+ + h\nu$ and leading to CH by dissociative recombination of CH_2^+ and by photodissociation of CH_2 and CH_3. The CH molecules are photoionized to produce CH^+ which reacts rapidly with H_2 to reform CH_2^+. If carbon is depleted by a factor of three, the observed abundance of CH is consistent with a value of 10^{-16} cm^3 s^{-1} for the rate coefficient of the radiative association of C^+ and H_2. Because CH^+ is destroyed rapidly by H_2, it is proposed that the CH molecules exist in a dense central core composed mostly of H_2 and the CH^+ molecules in a diffuse extended envelope composed mostly of H. The molecule CH_3 may be present with an abundance approaching that of CH. (auth)

19287 RELATIVISTICALLY INDUCED INTERSTELLAR DENSITY FLUCTUATIONS. Stewart, P. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 24: No. 1, 269-277(Sep 1973).

The spectrum of cold electron density fluctuations induced by a relativistic electron gas is investigated and the results discussed in relation to the interstellar medium. (auth)

19288 GAS TO DUST RATIO IN NGC 6523. Tenorio-Tagle, G. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 24: No. 1, 175-180(Sep 1973).

On the basis of an electron density distribution deduced from radio observations, the gas to dust ratio in NGC 6523 is determined, and found to be constant throughout the nebula. The results are in agreement with the observations made by O'Dell et al. (1966). (auth)

19289 DEPOLARIZATION OF LIGHT BY INTERSTELLAR MAGNETIC TURBULENCE. Bourret, R. (Observatorie de Meudon, France). Astrophys. Space Sci.; 24: No. 2, 407-419 (Oct 1973).

The application of stochastic peturbation theory to the propagation of electromagnetic radiation in a cold plasma with random magnetic inhomogeneities leads to a field equation for the propagation of the coherence matrix of the field. This has nine independent components since the longitudinal mode must be included. An exact solution is obtained leading to simple expressions for the Stokes parameters as a function of distance and one physical parameter characterizing the interstellar plasma. While the total polarization decays exponentially, it is found that the ratio of elliptical to linear polarization increases with propagation idstance in an exponential fashion. Using current estimates of the properties of the interstellar plasma it is expected that this effect whereby the polarization ellipse opens into a circle should be clearly evident for sources at distances of the order of 10 parsec. It is suggested that this phenomenon might be used as a distance scale for certain objects. (auth)

19290 POTENTIAL ENERGY OF GRAVITATIONALLY INTERACTING DISK GALAXIES. Ballabh, G. M.. (Osmania Univ., Hyderabad, India). Astrophys. Space Sci.; 24: No. 2, 535-561(Oct 1973).

Methods are developed for analyzing the gravitational properties of disks having circularly symmetric distribution of matter. It is shown how this can be conveniently done by assuming that the surface density distribution may be approximated

by a polynomial in ascending powers of the distance from the center of the configuration. A theory has been developed to determine the gravitational potential of a single disk at any point in space in terms of the coefficients of the polynomial defining the surface distribution of matter, and the potential energy of two disks of arbitrary separation and orientation due to their mutual gravitational attraction. The basic functions, required for obtaining the potential in the plane of the disk and the mutual potential energy of two coplanar disks, have been tabulated. Two overlapping coplanar disks attract just like mass-points at a certain separation, r_c, of their centers. The force of attraction of disks is less than the force of attraction of mass-points having masses equal to the masses of the disks, if the separation of the centers is less than r_c, and greater if the separation is greater than r_c. For typical galaxies of equal radii R, $r_c \approx R$. (auth)

Cosmology

Refer also to abstracts 19187, 19309, and 19921.

19291 EQUATIONS OF STATE OF HOOKEAN SYMMETRY SYSTEMS. Dubois, J. G. (Univ. of Quebec, Rimouski). Can. J. Phys.; 51: No. 16, 1757-1764(15 Aug 1973). (In French).

A cosmological but nonrelativistic generalization of the Galilean kinematic is given by the Hooke groups. For the corresponding universes, the Hookean invariant systems state equations are deduced. One particularly studies the spin-0 and the -½ cases, the Hooke analogs of the Schrödinger and Pauli equations. The classical limit, that is the Hamilton-Jacobi equation, is also considered. (auth)

19292 TWO AXISYMMETRIC BLACK HOLES CANNOT BE IN STATIC EQUILIBRIUM. Hagen, H. M. Z.; Seifert, H. J. (Univ., Hamburg). Int. J. Theor. Phys.; 8: No. 6, 443-450(1973).

No static equilibrium configuration of two black holes can exist in an axisymmetric asymptotically flat vacuum space-time. (auth)

19293 MAGNETIC FIELDS IN THE EARLY UNIVERSE. Harrison, E. R. (Sussex Univ., Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 165: No. 2, 185-200(1973).

Primordial turbulence in the radiation-dominated era of the early Universe had an associated weak seed magnetic field on all scales of the turbulence. This seed field was stochastically amplified by the small-scale rapidly fluctuating turbulence motions and it is possible, in principle at least, for magnetic and small-scale kinetic energies to have attained equipartition within an expansion time. It is unlikely that the magnetic energy attained equipartition with the large-scale kinetic energy of the turbulence. The intensity of the field is $\sim 10^9$ Gauss at temperature $T = 10^9$ K and $\sim 10^2$ Gauss at $T = 10^5$ K. Field generation ceased at approximately the epoch of equal radiation and matter densities. Some implications of the primordially generated field are considered. It is shown that the Jeans mass, owing to magnetic stresses, is of galactic magnitude and plays a crucial role in galaxy formation. It is estimated that the present intergalactic magnetic field has an intensity of $\sim 10^{-6}$ Gauss and a dominant scale-length ~10 kpc. Some brief comments are made on the possibility of ion acceleration by agitated magnetic fields during and after the radiation era. (auth)

19294 IS THE UNIVERSE A VACUUM FLUCTUATION? Tryon, E. P. (Hunter Coll., New York). Nature (London); 246: No. 5433, 396-397(14 Dec 1973).

A big-bang model is proposed in which the Universe is a fluctuation of the vacuum, in the sense of quantum field theory. The model predicts a Universe which is homogeneous, isotropic and closed, and consists equally of matter and antimatter. All these predictions are supported by, or consistent with, present observations. (auth)

19295 COSMOLOGICAL PRINCIPLE IN NEWTONIAN UNIVERSES. Evans, A. B.; Davidson, W. (Otago Univ., Dunedin, N. Z.). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 323-336 (1973).

The cosmological principle normally employed in Newtonian cosmology is briefly reviewed, and a wider interpretation is proposed which does not include the assumption that the equivalent reference frames are similarly oriented. This leads to a formulation based on groups of motions of a Euclidean 3-space, and thus analogous to that of homogeneous world models in general relativity. The usual linear-velocity universes are obtained as one of two possible cases; the other is a new class of Newtonian universes having a partly non-linear velocity function. (auth)

19296 PROBLEM OF THE INITIAL STATE IN THE ISOTROPIC SCALAR-TENSOR COSMOLOGY OF BRANS-DICKE. Gurevich, L. E. (Physical-Technical Inst., Leningrad); Finkelstein, A. M.; Ruban, V. A. Astrophys. Space Sci.; 22: No. 2, 231-242(Jun 1973).

In connection with the problem of the initial singularity in the framework of the Brans-Dicke scalar-tensor isotropic cosmology, the dynamics of the early stages of the expansion is studied on the basis of the general analytical solutions for flat models with $P = n\epsilon$ $(0 \leq n \leq 1)$. The sourceless scalar field, which plays a role of effective source of the geometry, entirely changes the character of the initial expansion, whereas in the absence of it the dynamics of the models almost does not differ from GR-case. If the connecting parameter $\omega < -6$ then the sourceless scalar field removes the initial singularity for any equations of state, and provides the regular transition from the compression to the expansion through the nonstationary state with $\dot{\varphi} \neq 0$. If ω is positive, the singularity of vacuum nature necessarily exists; the sourceless scalar-field being prevalent over the material sources (at least for $P \leq \frac{1}{3}\epsilon$) near the singularity. For $P > \frac{1}{3}\epsilon$ parallel with the vacuum singularity the singular initial state with dominant role of gravitating matter is possible. In the course of expansion, the influence of gravitating matter and curvature—which as nonessential at the early stage in comparison with sourceless φ-field—becomes dominant, and all models approach the "Machian" ones which differs slightly from corresponding GR-models. If ω is negative ($\omega < -6$) the sourceless φ-field slows down the initial expansion and increases essentially the real age of the Universe; it can also influence the primordial nucleosynthesis by diminishing in particular the content of ^{4}He. It is shown that a knowledge of the sign G gives information about the nature of the initial Universe state. (auth)

19297 DEUTERIUM FORMATION HYPOTHESIS FOR THE DIFFUSE GAMMA-RAY EXCESS AT 1 MeV. Leventhal, M. (Bell Telephone Labs., Inc., Murray Hill, NJ). Nature (London); 246: No. 5429, 136-138(16 Nov 1973).

It is stated that measurements of the diffuse x-ray and γ-ray background indicate that it shows an inverse power law spectrum with index ~2.0. Spectral excesses have been reported in the vicinity of ~40 keV and ~1 MeV. When plotted on linear-linear paper the 1 MeV excess shows a pronounced peak in the 0.5 to 2.0 MeV region, with a feeble tail extending to higher energy. A simple explanation is presented for the 1 MeV peak in the light of new experimental and theoretical advances. It is postulated that the peak arises from the astrophysical production of D by the two body recombination process $p + n \rightarrow D + 2.2$ MeV γ rays in an environment transparent to the γ rays. This hypothesis leads to two remarkable numerical results: a calculation of the terrestrial n(D)/n(H) ratio, and a prediction of QSO cut offs at $z \sim 3$. Measurements of the γ-ray background made on Apollo 15 have confirmed the 1 MeV feature, and in the discussions presented these measurements are used, since they are the most recent and span both the power law and 1 MeV excess regions of the spectrum. (UK)

19298 REDSHIFTS AND NUMBER COUNTS OF EXTRAGALACTIC OBJECTS IN TWO COSMOLOGICAL MODELS. Krieger, C. J.; Solheim, J. E. Astrophys. Space Sci.; 23: No. 2, 325-338(Aug 1973).

Observed redshifts and magnitudes of seven classes of extragalactic objects, and number counts of quasars are compared with predictions made by cosmological models. The uniform model U 1 and the proposed nonexpanding model RHL 5 represent the observations very well. The latter offers numerous advantages. Absolute magnitudes and colors are determined. (auth)

19299 HADRONIC FIREBALL AND GALAXY FORMATION. Sistero, R. F. (Univ., Cordoba, Argentina). Astrophys. Space Sci.; 24: No. 1, 181-187(Sep 1973).

If the formation of galaxies was triggered off by energy density fluctuations in the hadronic era of the Universe, then the mass spectrum of galaxies (and galaxies in clusters) is given by the thermodynamics of strong interactions. An observational test is proposed. (auth)

19300 EXACT SOLUTIONS FOR FRIEDMANN MODELS WITH RADIATION. Edwards, D. (Thames Polytechnic, London). Astrophys. Space Sci.; 24: No. 2, 563-575(Oct 1973).

Exact expressions are given for the properties of the general expanding Friedmann model Universe with non-zero cosmological constant and containing noninteracting matter and radiation. (auth)

Planetary Phenomena

Refer also to abstract 19217.

19301 CALCULATION OF THE STREAMLINING OF THE ATMOSPHERE OF SPHERICAL BODIES WITH SUPERSONIC GAS FLOW. Mitnitskii, V. Ya. Zh. Vychisl. Mat. i Mat. Fiz.; 13: No. 4, 1060-1064(1973). (In Russian).

The supersonic stationary streamlining of the atmosphere contained by gravitational forces around a spherical body was examined. It was assumed that the exterior stream is separated from the quiescent atmosphere by tangential discontinuities. A numerical method was developed which makes it possible, together with the parameters of the flow in the collision layer, to determine the form of the tangential discontinuity and the collision waves. In addition to the independent values (streamlining by solar winds of the atmosphere of planets with weak intrinsic magnetic fields) this method makes it possible to demonstrate a method for the calculation of the streamlining of bodies developed basically for the solution of very complex three-dimensional self-adjoint problems on the MHD streamlining of geomagnetic dipoles. (JSR)

19302 INTERACTION OF THE SOLAR WIND WITH THE OUTER PLANETS. Dryer, M. (National Oceanic and Atmospheric Administration, Boulder, CO); Rizzi, A. W.; Shen, W. W. Astrophys. Space Sci.; 22: No. 2, 329-351(Jun 1973).

The hypersonic analog for the interaction of the solar wind with Jupiter, Saturn, Uranus, Neptune, and Pluto is used to provide estimates of shock shapes and locations as well as average magnetosheath and/or ionosheath properties for these planets. Several representative spacecraft flyby trajectories (designed for outer-planet "Grand Tour" simulations) are superimposed upon a series of figures in order to provide estimates of potential plasma and field parameters which may be encountered. Consideration is given first to the possibility that several of these planets have intrinsic magnetic fields and, secondly, to the interaction of the solar wind directly on the ionosphere should there actually be no intrinsic field. Saturn and Pluto are chosen as examples of this latter case. (auth)

19303 PLANETARY FORMATION BY THE ACCUMULATION OF SUBCONDENSATIONS. Williams, I. P.; Donnison, J. R. (Queen Mary Coll., London). Mon. Notic. Roy. Astron. Soc.; 165: No. 3, 295-303(1973).

The accumulation of a large number of cloudlets into a few condensations is investigated, principally by means of a computer simulation of the process. It is concluded that it is possible to form near coplanar systems but that many collisions are required to bring about this state. (auth)

19304 PLANETARY ALIGNMENTS, SOLAR ACTIVITY, AND CLIMATIC CHANGE. Gribbin, J. Nature (London); 246: No. 5434-5435, 453-454(21 Dec 1973).

Historical data suggest a relation between the changing level of solar activity and climatic change on Earth. Since there is also evidence that the solar cycle of activity is influenced by the alignments of the planets, through tidal interactions with the Sun, it seems that climatic change might be predicted by studying these alignments. (auth)

19305 PRODUCTION OF ORGANIC MOLECULES BY PROTON IRRADIATION. Scattergood, T.; Lesser, P.; Owen, T. (State Univ. of New York, Stony Brook). Nature (London); 247: No. 5436, 100-101(11 Jan 1974).

An energy source worthy of consideration for the production of organic molecules in primitive planetary atmospheres is stated to be energetic protons in the solar wind and in planetary radiation belts. The satellites of the outer planets are exposed to the solar wind, and two of these, Io and Titan, are unusually red; Titan is especially interesting as it is known to possess an atmosphere containing H_2 and CH_4. Protons can also bombard a planetary atmosphere directly from discharges in the radiation belts. Experimental work is described which was carried out to investigate the effectiveness of proton irradiation for producing organic chromophores; 2-MeV protons from a tandem Van de Graaff machine were used for the irradiations, and the beams employed ranged from 870 down to 220 nA. Based on the nominal model for the flux in Jupiter's radiation belt at six Jupiter radii from the planet (approximately the distance of Io) these beams correspond to 1.72 and 0.43 earth years at Jupiter per second of exposure. Five gas mixtures were used in the experiments, none of which contained water. The first irradiation cell, exposed to 870 nA for 3 hr, contained CH_4 and NH_3, and high resolution mass spectrometry of the gas phase indicated the presence of C_2H_2, C_2H_4, and C_2H_6 plus their methyl homologues, as well as C_4H_2, CH_3CN, and residual CH_4 and NH_3. The brown oily liquid produced was analyzed by computer-assisted gas chromatography–mass spectrometry, which indicated the presence of the expected alkyl hydrocarbons and alkylamines. Some unexpected and interesting products included tricyclic alkylamines, hexamethylene tetramine and its methyl and dimethyl homologues. In the second experiment, the total dose was reduced by half. In this case, lower molecular weight molecules were enriched relative to those of higher molecular weight. In the third experiment a mixture of CH_4, NH_3, and H_2S was used: the gas phase contained several simple hydrocarbons saturated and unsaturated, with some CH_3CN and $(CH_3)_2S$. The gas chromatogram of the liquid formed indicated the presence of a series of alkyl di- and tri-sulfides, starting with $(CH_3)_2S_2$ and increasing in alkyl chain length; its yellow color was found to be due to free polymeric S. This result was very interesting, since S and ammonium polysulfides have been proposed to account for the yellow color on Jupiter. In experiment four a mixture of CH_4 and N_2 was used; the gas phase contained the same species as in the case of CH_4 and NH_3, but the liquid contained a much larger proportion of alkylamines relative to cyclic amines. The last cell contained only CH_4 and was run as a check on possible contributions of impurities in the apparatus to the irradiation products. It was obvious from the results that energetic protons can be an effective energy source for the formation of complex molecules from simple molecules. The presence of N or S seems to be necessary for the formation of colored products. (UK)

19306 MEASUREMENT OF RADIO EMISSION OF JOVIAN SATELLITE CALLISTO. Kuz'min, A. D.; Losovskii, B. Ya. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 4, 804-805(1 Aug 1973). (In Russian).

Values for the luminescence temperature of the radio emission of Callisto at 8.2 mm wavelength obtained were practically the same as the value 250 ± 80°K derived from measurements of Gorgolevski at 3.5 mm. This confirms the high luminescence temperature of the radio emission of Callisto and indicates a heat mechanism for this radiation. The agreement between measured and calculated (by a model for an ice surface of Callisto) is an argument in favor of the ice surface hypothesis. (TTT)

19307 STRUCTURE AND EVOLUTIONARY HISTORY OF THE SOLAR SYSTEM. III. Alfven, H.; Arrhenius, G. (Univ. of California, San Diego, La Jolla). Astrophys. Space Sci.; 21: No. 1, 117-176(Mar 1973).

Parts I and II of this analysis of the evolution of the solar system have been devoted mainly to the mechanical processes. The present part deals primarily with the plasma processes and the hydromagnetic aspects. Much confusion in the cosmogonic field is due to the treatment of the early phases of the evolution of a circumstellar medium by prehydromagnetic methods, or by erroneous application of magnetohydrodynamics. In order to reduce the speculative element as far as possible, the present analysis tries to connect the cosmogonic processes as directly as possible to laboratory plasma physics and to space phenomena actually observed today. Models of the Laplacian type have been made obsolete by magnetohydrodynamics. Furthermore, they are in conflict with observations. A new model is suggested. A plasma surrounding a rotating central body may attain a state of partial corotation, which is determined by the balance between gravitation and the centrifugal force acting on a plasma in a dipole field. Condensation from a partially corotating plasma results in grains orbiting in ellipses with $e = 1/3$ and finally accreting to bodies at $2/3$ of the central distance of the point of condensation. An application of the theory to the Saturnian rings and to the asteroidal belt shows that the fall-down ratio $2/3$ (derived from the geometry of a dipole field) is essential for the understanding of their structure. The structure of the groups of planets and satellites is also discussed, but only in a preliminary way. The behavior of volatile substances is a major problem which still awaits an appropriate treatment. (20 figures, 3 tables, 100 references) (auth)

19308 PIONEER 10: THE PRELIMINARY RESULTS. Hunt, G. (Meteorological Office, Bracknell, Eng.). New Sci.; 61: No. 881, 125-127(17 Jan 1974).

Pioneer 10 reached the point of closest approach to Jupiter (2.86 Jupiter radii or R_J) at 02:25:19 GMT on 4 December 1973. Pioneer 10 has now become the first spacecraft to travel beyond the orbit of Mars, through the asteroid belt, and through the intense Van Allen radiation belts which surround Jupiter. The large amount of information which has been reaching Earth from Pioneer 10 has revealed many facts previously unknown and opened new speculations about Jupiter and its rich satellite system. Characteristics of the Jovian environment which have become evident from this experiment and which are discussed here include the strength of the magnetic field, the radiation belts, which are regions where protons and high-energy electrons are trapped by the planet's magnetic field, and the effect of the radiation belts of the Jovian satellites. The fact that helium has been positively detected for the first time in Jupiter's atmosphere by dayglow observations recorded by Pioneer 10's ultraviolet photometer is considered. The infrared radiometer used measured a brightness temperature of 145 K for Jupiter which, using a planetary albedo of 0.45, confirms that the planet emits more than twice the amount of energy it receives from the Sun. The significance of this result is discussed. The images returned

from Pioneer 10, providing the first closeup look at the planet, are considered. (UK)

19309 COMETS AND THE FORMATION OF PLANETS. Oepik, E. J. (Armagh Observatory, Ireland). Astrophys. Space Sci.; 21: No. 2, 307-398(Apr 1973).

A morphological study of the physical and dynamical processes of planet formation is presented, with emphasis on the intermediary role of comet nuclei. Although guided by a particular model of the evolution of the pre-planetary solar nebula, implying the freezing-out of hydrogen in the region of the giant planets, the derivations and conclusions are of wider import, applicable to other cosmogonic models as well as to certain phases of star formation. The items evaluated physically, dynamically, or statistically comprise: the total number mass of comets in Oort's cloud; a re-evaluation of the diameters and masses of cometary nuclei; the processes of nucleation from gravitational and "Boltzmann" instabilities of gaseous media to agglomerations of particulate matter as conditioned by inbuilt angular momentum; the statistical-dynamical conditions and time scales of orbital interaction of comets with the planets and the consequences of disintegration. A consistent model proposes the formation of comets and planets in pre-planetary rings of the residual solar nebula, with subsequent ejection, chiefly by Jupiter, of the comets to Oort's sphere. Screening by absorbing matter is not only probable, but necessary to protect the comets from disintegration during the process of ejection. (auth)

19310 GEOMAGNETIC LINE SPECTRA: 2 TO 70 YEARS. Currie, R. G. (CSIR, Hermanus, South Africa). Astrophys. Space Sci.; 21: No. 2, 425-438(Apr 1973).

Application of a new data adaptive approach to power spectrum estimation has yielded greatly improved knowledge of the geomagnetic spectrum in the range 2 to 70 yr. The first successful line spectrum detection of the solar and double solar cycle variations in absolute geomagnetic element data is presented; also detected are the first four harmonics of the solar cycle and, excepting one, the first nine harmonics of the double solar cycle. Finally, evidence is found for a ~60 yr line. The implications of these results for a variety of problems in planetary and space physics are discussed. (auth)

19311 GEOMAGNETIC TAIL OSCILLATIONS IN QUASI-HYDRODYNAMICS. Ershkovich, A. I.; Martyanov, S. A. Astrophys. Space Sci.; 21: No. 2, 451-460(Apr 1973).

The effect of pressure anisotropy on geomagnetic tail oscillations is studied using the Chew–Goldberger–Low equations. It is shown that anisotropy of the solar wind plasma pressure may result in generation of waves, assuming no waves in the case of isotropy. Anisotropy of the plasma pressure in the magnetospheric tail may also cause a basic distortion of the oscillation spectra. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 19083, 19253, and 19254.

19312 INFRARED SPECTRUM OF THE AIRGLOW. Vallance Jones, A. (National Research Council of Canada, Ottawa). Space Sci. Rev.; 15: No. 2/3, 355-400(1973).

The techniques of studying the ir airglow are briefly discussed followed by a review of recent observations. The main emphasis is on the molecular emissions of OH and O_2 from the mesosphere and lower thermosphere with a shorter discussion of the F-region atomic emissions. The theoretical interpretations of these emissions are reviewed. It is concluded that dynamic effects must play a dominant and as yet incompletely understood part in the photochemistry of the molecular emission region. An atlas of recently available airglow spectra is included. (auth)

19313 ESTIMATION OF THE LOSS COEFFICIENT IN THE F-REGION OF THE IONOSPHERE. Khocholava, G. M.; Mebagishvili, N. N. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 3, 601-604(Sep 1973). (In Russian).

The results of the loss coefficient β' estimation in the F region are cited from the balance equation of ionization in the nocturnal conditions using N(h) profiles. The tendency of β' to increase with the growth of the geomagnetic activity level has been observed. The height distribution $\beta'(h)$ having the exponential character of change has been derived. (auth)

19314 WINDS AND DRIFTS IN THE IONOSPHERE. Kazimirovskii, E. S. Vestn. Akad. Nauk SSSR; 52-62(Jul 1973). (In Russian).

An energy distribution chart is proposed for dynamic processes occurring in the ionosphere. The chart incorporates particle precipitation and heating, hydromagnetic and gravitational waves, plasma and neutral gas motions, solar and lunar gravitational tides, geomagnetic field variations, and periodic solar thermal energy variations. Experimental studies of ionospheric motions covering a period of over two decades are reviewed. Also included are a wind measurement diagram obtained with artificial clouds, an averaged wind model of the Northern Hemisphere, diurnal horizontal drift velocity curves in the F region, and a wind system diagram for an altitude of 300 km. (IAA)

19315 NUMERICAL SOLUTIONS TO THE PROBLEM OF CHARGED PARTICLE FLOW AROUND AN IONOSPHERIC SPACECRAFT. Martin, A. R. (The City Univ., London). Planet. Space Sci.; 22: No. 1, 121-141(Jan 1974).

The interaction of a conducting body moving through the ionosphere with the surrounding plasma is treated numerically. The Poisson and Vlasov equations are solved using computer techniques to give information about the redistribution of charged particles in the wake behind the body and the perturbation of the electric potential sheaths around the body. Three cases of interest are studied: body size less than, equal to, and greater than the Debye length in the surrounding plasma. A range of body potentials and ion Mach numbers are considered which are typical of conditions found in the ionosphere. Wake features, such as ion-free wake lengths and angles of propagation of disturbances in the wakes, are investigated for these conditions. Physical pictures of the mechanisms of wake formation behind a plate and a disc are built up for the three classes of body size, and differences due to geometry or size are explained. The smaller bodies are comparable in size to instrument booms, diagnostic probes, antennae, etc. and the larger bodies approach the dimensions of ionospheric satellites and space probes. (auth)

19316 INDUCED WAVE SCATTERING IN IONOSPHERIC PLASMA. Mityakov, N. A.; Rapoport, V. O.; Trakhtengerts, V. Yu. (Scientific-Research Radiophysics Inst., Gorky, USSR). Planet. Space Sci.; 22: No. 1, 95-98(Jan 1974).

Parametric excitation of plasma oscillations in the ionosphere by an electromagnetic wave near the reflection level has been considered. The spectrum of plasma waves forms as a result of action of the source (a pump wave), nonlinear transfer towards large scales and damping. The results of the theory are in satisfactory agreement with the experiment. (auth)

19317 THERMAL PROTON FLOW IN THE PLASMASPHERE. The Morning Sector. Banks, P. M.; Doupnik, J. R. (Stanford Univ., CA). Planet. Space Sci.; 22: No. 1, 79-94(Jan 1974).

Vertical profiles of electron density obtained in the vicinity of the plasmapause using the Alouette-II topside sounder have been analyzed to assess the presence of H^+ flow in the topside ionosphere. The observations in the midnight sector show clearly the presence of the plasmapause; i.e., there is a sharp boundary separating the poleward regions of polar wind H^+ flow and the more gentle conditions of the plasmasphere where light ions are present in abundance. In contrast, in the sunlit morning sector upwards H^+ flow is deduced to be present to invariant latitudes as low as 48° (L = 2.2) in the regions normally known to be well inside the plasmasphere. The upwards H^+ flux is sufficiently large (3×10^8 ions cm^{-2} sec^{-1}) that the plasmapause cannot be seen in the latitudinal electron density contours of the topside ionosphere. The cause for this flow remains unknown but it may be a result of a diurnal refilling process. (auth)

19318 BEHAVIOUR OF ION VELOCITY DISTRIBUTIONS FOR A SIMPLE COLLISION MODEL. St. Maurice, J. P.; Schunk, R. W. (Yale Univ., New Haven). Planet. Space Sci.; 22: No. 1, 1-18(Jan 1974).

For application to studies of the high-latitude ionosphere, ion velocity distributions for a weakly-ionized plasma subjected to crossed electric and magnetic fields have been calculated. An exact solution to Boltzmann's equation has been obtained by replacing the Boltzmann collision integral with a simple relaxation model. At altitudes above about 150 km, where the ion collision frequency is much less than the ion cyclotron frequency, the ion distribution takes the shape of a torus in velocity space for electric fields greater than 40 mV m^{-1}. This shape persists for 1 to 2 hr after application of the electric field. At altitudes where the ion collision and cyclotron frequencies are approximately equal (about 120 km), the ion velocity distribution is shaped like a bean for large electric field strengths. This bean-shaped distribution persists throughout the lifetime of ionospheric electric fields. These highly non-Maxwellian ion velocity distributions may have an appreciable effect on the interpretation of ion temperature measurements. (auth)

19319 TRANS-AURORAL ZONE AURORAL INFRASONIC WAVE OBSERVATIONS. Wilson, C. R. (Univ. of Alaska, College). Planet. Space Sci.; 22: No. 1, 151-173(Jan 1974).

The auroral infrasonic wave (AIW) substorm morphologies are compared for two trans-auroral zone stations, Inuvik, N.W.T. Canada (70.4° dip lat) and College, Alaska (64.6° dip lat), that lie along the same magnetic meridian with a north–south separation of 738 km. Statistical studies of the number of AIW received at College over a 5 yr period and at Inuvik over a 2 yr period as well as studies of individual auroral substorms observed at both stations have shown that in the morning sector many more AIW are observed at College than at Inuvik. This difference is related to the changing location of the westward auroral electrojet with local time (Weins and Rostoker, 1973). The distribution of frequency of occurrence of AIW horizontal trace velocity V_h is presented for College data together with a discussion of the effects on the distribution of (1) source speed, (2) wind shear, (3) geometry of the AIW mach cone with respect to the observing station, (4) the filtering of AIW with high ray path apogees, and (5) the decrease in AIW amplitude with increasing mach number. (auth)

19320 MEASUREMENT OF ELECTRON TEMPERATURES IN THE LOWER IONOSPHERE BY DETECTING THE SPACE POTENTIAL ON THE LANGMUIR PROBE CHARACTERISTIC. Subbaraya, B. H.; Prakash, S.; Gupta, S. P.; Sinha, H. S. S. (Physical Research Lab., Ahmedabad, India). Planet. Space Sci.; 22: No. 1, 180-181(Jan 1974).

Electron temperatures have been determined at Thumba on Nike Apache flight 10.11 (March 12, 1967, 1857 hr IST) by the usual retarding potential analysis and by using an ac modulation technique for detecting the space potential on the Langmuir probe characteristic. Simultaneous measurements with the two techniques show that the space potential technique gives temperatures which are related to the temperatures obtained from the retarding potential analysis in a manner remarkably similar to the relations obtained by Booker and Smith (J. Atmos. Terr. Phys.; 32: 467 (1970)) as well as by Carlson and Sayers (J. Geophys. Res.; 75: 4883 (1970)) between radar temperatures and dc probe temperatures. This result is interesting in view of the fact that radar temperatures have been found to be in good agreement with the temperatures obtained by ac modulation techniques on satellite borne probes. The space potential technique is simple, requires limited additional electronics, does not make stringent demands on telemetry and can be easily adopted for rocket borne Langmuir probes. (auth)

19321 IONOSPHERIC MOTIONS AT LOW SOLAR INCIDENCE. Soicher, H. (Army Electronics Labs., Monmouth, NJ). Nature (London) Phys. Sci.; 245: No. 148, 131-132(29 Oct 1973).

Reference is made to the author's earlier publication (J. Atmos. Terr. Phys., 35: 657(1973)) in which he discussed the behavior of topside ionospheric densities and scale heights during the sunrise period for the time period May 21 to July 4, 1963. The data used included a large number of ionograms taken from Alouette I for different solar zenith angle ranges between 121 and 85°. On the assumption that the ionosphere is in a state of diffusive equilibrium the scale heights were interpreted in terms of combined electron and ion temperature distributions and relative ion concentrations. In the present communication the author explores the possibility that the ionosphere is not in a state of diffusive equilibrium and the existence of nonzero ambipolar flux density caused by increases in particle temperature due to increased solar illumination. The scale height distribution obtained previously showed variations with latitude and with solar zenith angle at 450 km; these are now interpreted in terms of mean ambipolar flux densities. (UK)

19322 MERIDIONAL F2-REGION PLASMA DRIFTS AT MALVERN. Taylor, G. N. (Royal Radar Establishment, Malvern, Eng.). J. Atmos. Terrest. Phys.; 36: No. 2, 267-286(Feb 1974).

A new multistatic CW incoherent scatter radar system is described, and its use for measuring F2-region plasma drifts in the magnetic meridian plane is explained. Hourly values of velocity components $V_{||}$ and $V_{\perp N}$ (parallel to and perpendicular to the geomagnetic field) are presented for 10 days between December 1971 and July 1972. $V_{||}$ has a fairly regular diurnal variation, similar to that observed at other sites, but $V_{\perp N}$ shows marked day-to-day and hour-to-hour fluctuations, and much larger extreme values than $V_{||}$. The occurrence of changes in $V_{||}$ induced by $V_{\perp N}$ during the day is demonstrated directly. After correction for this induced drift, the remaining field parallel component has diurnal variation in much better agreement with theoretical prediction for drifts due to thermospheric winds and diffusion than was $V_{||}$. The most persistent feature of the diurnal curves of $V_{\perp N}$ is a negative-going episode that occurs near noon. This is inconsistent with driving electric field patterns produced by diurnal tidal winds in the dynamo region. On some days the observed variation of $V_{\perp N}$ is consistent with a model of Matsushita (Gerlands, Beitr Geophysik (Leipzig); 80: 91(1971)), which takes account of convective plasmaspheric motions. (auth)

19323 BEHAVIOUR OF THE POLAR IONOSPHERE UNDER THE INFLUENCE OF INCIDENT ELECTRON FLUX. Moschandreas, D. J.; Tuan, T. F. (Univ. of Cincinnati). J. Atmos. Terrest. Phys.; 36: No. 2, 287-303(Feb 1974).

The effect of incident electron flux on the behavior of the winter polar ionosphere is investigated by using Green's function and integral equations. The treatment assumes a one spatial dimensional model and includes diffusion, recombination, and production from the electron flux. Different incident electron energy spectra in the soft electron zone outside the polar cavity have been used to compute the steady state electron density profiles. The effect of UT control of the diurnal variation in the incident electron flux is analyzed using the time variation in the incident energy flux given by Maehlum (J. Atmos Terr. Phys.; 31: 1003(1969)). The results show a UT variation in the foF2 consistent with observations. It will be shown that UT variation in the electron flux can also produce large variations in hmF2 which, however, must show some correlation with foF2 in the absence of other effects. (auth)

19324 PROTONOSPHERIC COLUMNAR ELECTRON CONTENT DETERMINATION. 2. Observations. Almeida, O. G. (Stanford Univ., CA). J. Atmos. Terrest. Phys.; 36: No. 2, 305-313(Feb 1974).

Over 300 hr of measurements of the quantity I_w—the difference between total columnar electron content, derived from the differential phase-path data, and Faraday electron content—is presented. The interpretation of the measurements in terms of protonospheric content is discussed under the light of a previous analysis (Almeida, J. Atmos. Terr. Phys.; 35: 1657(1973)), which demonstrates that good protonospheric content measurements can only be obtained under certain geometries of observations unless information on the shape and height of ionospheric layer is available. A strong correlation between I_w and the ionospheric content is observed in most of the Arecibo data because they were collected under unfavorable conditions. The Stanford data, on the other hand, yield good measurements of the protonospheric content. The May 1969 observations show a strong depletion of protonospheric content during a magnetic storm and its subsequent recovery. This is in general agreement with flux tube content behavior observed by the whistler technique during similar conditions. (auth)

19325 EFFECTS OF NEUTRAL WINDS AND ELECTRIC FIELDS ON THE IONOSPHERIC F2-LAYER OVER ARECIBO. Behnke, R.; Kohl, H. (Case Western Reserve Univ., Cleveland). J. Atmos. Terrest. Phys.; 36: No. 2, 325-333(Feb 1974).

Neutral air velocities at F-region heights, electric fields and hmF2 were measured for eight nights by the Arecibo radar. The wind velocities and electric fields were used in a computer program which solved the continuity equation for the F region. The calculated hmF2 and foF2 variations were then compared to backscatter measurements and ionograms. It was shown that for most of the time, the effect of the winds predominates over that of electric fields. In particular, the evening rise and the subsequent "midnight collapse" of the F region are almost entirely caused by neutral air winds. There are, however, certain occasions especially around 0400 LT where electric fields are also important. (auth)

19326 DOWNWARD TRANSPORT OF NIGHTTIME Es-LAYERS INTO THE LOWER E-REGION AT ARECIBO. Rowe, J. F. (Arecibo Observatory, Puerto Rico). J. Atmos. Terrest. Phys.; 36: No. 2, 225-234(Feb 1974).

Incoherent scatter observations at the Arecibo Observatory have shown that nighttime electron density enhancements are formed in the upper E-region and move down to merge with a stable Es-layer lying between 105 to 110 km. The phenomenon is strongest in winter months, and is accompanied by the presence of an underlying Es-layer near 90 km. These observations provide support for a nighttime "corkscrew" mechanism which sweeps metallic ions down from higher altitudes and deposits them between 105 to 110 km. A statistical study of the wind shears necessary to maintain nighttime Es-layers suggests that strong layers lying below 110 km are composed primarily of long-lifetime metallic ions. (auth)

19327 AURORAL DISPLAYS NEAR THE FOOT OF THE FIELD LINE OF THE ATS-5 SATELLITE. Akasofu, S. I.; DeForest, S.; McIlwain, C. (Univ. of Alaska, College). Planet. Space Sci.; 22: No. 1, 25-40(Jan 1974).

A brief summary of an extensive correlative study of ATS-5 particle and magnetic field data is presented with all-sky photographs from Great Whale River which is near the "foot" of the field lines passing through the ATS-5 satellite. In particular, an effort is made to identify specific particle features with specific auroral displays during substorms, such as a westward travelling surge, poleward expansive motion, and drifting patches. Some of the important findings are (i) in early evening hours, the first encounter of ATS-5 with hot plasma is associated with the equatorward shift of the diffuse aurora, but not necessarily with westward travelling surges (even when the satellite is embedded in the plasma sheet). (ii) In the midnight sector, an injection corresponds very well to the initial brightening of an auroral arc. (iii) Specific features of morning sector auroras (for example, drifting patches) are difficult to correlate with specific particle features (gross features, but not specific). Comparing these results with particle data from low-latitude polar orbiting satellites, it is concluded that the plasma sheet near the earthward edge (consisting of plasmas injected during earlier substorms) is little affected during substorms. (auth)

19328 IONOSPHERIC TEMPERATURE AND DENSITY MEASUREMENTS BY MEANS OF SPHERICAL DOUBLE PROBES. Fahleson, U.; Faelthammar, C. G.; Pedersen, A. (Kungliga Tekniska Hoegskolan, Stockholm). Planet. Space Sci.; 22: No. 1, 41-66 (Jan 1974).

Rocket-borne double probes for electric field measurements can be intermittently operated in special, diagnostic modes involving current bias and low-impedance shunts to obtain information on the properties of the ambient ionospheric plasma along the flight path. Several such modes, and the information that they can provide, are analyzed. For example, in a low-impedance mode with asymmetric bias, the attenuation ratio (i.e., signal amplitude in this mode over the signal amplitude in the electric-field measuring mode) is in a simple way related to the electron temperature of the ambient plasma. The special surface coatings (Aquadag or vitreous carbon) normally used for electric field probes provide very homogeneous surface properties, a feature which also contributes to the reliability of the electron temperature measurements. In addition to electron temperature, the modes analyzed can be used to measure electron density and to give some information on ion temperature. The data from four rocket flights from ESRANGE are discussed in the light of these results. Electron temperature was measured in three of these flights. In all cases the temperature profile is in good agreement with theoretically predicted profiles based on the CIRA 1965 reference atmosphere and the solar illumination prevailing during the respective flights (twilight). Electron density profiles obtained by means of the double probe are in good agreement with the density measured by the Langmuir probe in the two flights for which both kinds of data are available. They are also in agreement with the electron density data available from ionosondes. Finally, pulses occurring when one of the probes passed through the rocket's shadow, are used to determine the photoelectron yield of the probe coatings (Aquadag or vitreous

carbon). The values obtained $(7 \pm 3) \times 10^{-4}$ A/m^2 for Aquadag and $(4 \pm 2) \times 10^{-4}$ A/m^2 for vitreous carbon are in good agreement with expectations based on laboratory data and solar Lyman α radiation. (auth)

19329 ULTRAVIOLET NIGHTGLOW SPECTRUM FROM 1900 A TO 3400 A. Cohen-Sabban, J.; Vuillemin, A. (CNRS, Marseille). Astrophys. Space Sci.; 24: No. 1, 127-132(Sep 1973).

Two spectra of the ultraviolet nightglow from 1900 Å to 3400 Å were recorded by a fast wide-field spectrograph during balloon flights from Aire sur Adour, France on September 15, 1969 and on October 5, 1970. These two spectra were composed of the O I line at 2972 Å, of the molecular oxygen Herzberg band system $A^3\Sigma_u^+ \rightarrow X^3\Sigma_g^-$, and of a molecular band system that seemed to belong to the NO δ System $X^2\pi \rightarrow C^2X^+$, situated at 1991 ± 4 Å, 2060 ± 4 Å, and 2136 ± 4 Å. Around 2540 Å, there was absorption by ozone at the altitudes at which the spectra were recorded (35 km and 40 km). The calculated value of ozone absorption at 35 km, and the zenith-horizon variation of the nightglow emission, are presented. (auth)

19330 BAHAVIOUR OF THE F-LAYER AT A LOW MIDLATITUDE STATION ON WINTER AND SUMMER NIGHTS AND COMPARISON WITH THE RESULTS OF A THERMOSPHERIC MODEL. Jones, K. L. (Univ. of Queensland, St. Lucia, Australia). J. Atmos. Terrest. Phys.; 36: No. 3, 397-406(Mar 1974).

The action of neutral air winds and of influx of plasma from outside the F layer is shown to be important in understanding its observed nighttime behaviour at a lower midlatitude station. On winter nights the problem is to understand why F-layer electron concentrations are as high as they are. On the other hand on summer nights the problem is to understand how the F layer decays as quickly as it does after large increases in F-layer electron concentrations which are observed to occur near midnight. The use of radio observations from a global network of stations could possibly lead to a model capable of predicting a wider range of ionospheric phenomena than is currently possible. (auth)

19331 LOW-LATITUDE SEASONAL ANOMALIES IN IONOSPHERIC ABSORPTION OF RADIO WAVES. Shirke, J. S.; Pradhan, S. N. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 36: No. 3, 537-543(Mar 1974).

Ionospheric absorption of radio waves at low latitudes is investigated. Harmonic analysis of noon time data from a number of stations shows the annual and semiannual periodicities to be important. The annual component is very weak at the geographic equator and by 30° north latitude increases to a peak amplitude of close to 40% of the annual average noon time absorption. The 6-monthly component is nearly constant with latitude and forms about 15% of the mean value. At the equator the predominant 6-monthly component gives rise to the so called "seasonal and summer" anomalies in ionospheric absorption. Besides solar zenith angle variations the origin of these anomalies is traced largely to similar variations in the incident solar ionizing x-ray flux. (auth)

19332 VLF RADIO TRANSMISSIONS AT SUNRISE. Schoute-Vanneck, C. A. (Univ. of Durban-Westville, Durban, South Africa). J. Atmos. Terrest. Phys.; 36: No. 3, 489-499(Mar 1974).

The effective reflection coefficient of the D region for vlf radio waves during sunrise is calculated by applying a full-wave technique to a model of the temporal distribution of free electrons in the lower ionosphere. Estimations are made of the field strength of signals propagated from a distant transmitter by a process of multiple reflections between the Earth and the ionosphere as the propagation path progressively comes under solar influence. The calculated fields are compared with observations made in the U.S.A. of transmissions from Panama (24 kHz) and Hawaii (23.4 kHz). The results indicate that variations in the field strength of vlf transmissions may be interpreted satisfactorily in terms of changes in the free electron content of the D region during sunrise. (auth)

19333 ELECTRON CONTENT AND ITS VARIATION OVER LINDAU. Tyagi, T. R. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 36: No. 3, 475-487 (Mar 1974).

Electron content and its variations over Lindau (51.6°N, 10.1°E) have been studied utilizing the 150 and 400 MHz transmissions from U.S. NNSS satellites during the year 1971. The general and characteristic features of diurnal and seasonal variations of total electron content (TEC) are outlined and compared with corresponding NmF2 variations. The experimental values have been compared with those calculated theoretically (after Stubbe, J. Atmos. Terr. Phys.; 32:865. (1970)). The appearance of nocturnal winter and evening summer maximum at Lindau has been studied in detail utilizing TEC measurements, obtained from the satellite S-66 transmissions over the period 1964 to 1968, and the foF2 values. The general features of these phenomena are outlined and the causes of their appearance discussed. It is found that night maximum occurs even in equinox 1 period (March to April) in TEC. This, however, does not appear in foF2 values though a very weak trend of a maximum around 02 to 03 hr could be noted in March 1965 and 1966. (auth)

19334 FOCUSSING OF RADIO WAVES BY LARGE SCALE IONOSPHERIC IRREGULARITIES. Jones, J.; Lyon, G. F. (Univ. of Western Ontario, London). J. Atmos. Terrest. Phys.; 36: No. 3, 461-473(Mar 1974).

A three-dimensional theory of focussing of radio waves by large scale ionospheric irregularities has been developed and has been applied to two cases: the travelling ionospheric wave and the spheroidal irregularity. With realistic models for the ionospheric perturbation the enhancement due to focussing can be of the order of 10 dB at a frequency of 40 MHz. Records of signals received from Explorer 22 have been examined and several examples of this focussing effect are presented. (auth)

19335 VERTICAL TRANSPORT OF PLASMA IN THE NIGHTTIME IONOSPHERE. Jain, A. R.; Williams, P. J. S. (University Coll. of Wales, Aberystwyth). J. Atmos. Terrest. Phys.; 36: No. 3, 417-424(Mar 1974).

A new method is proposed for obtaining the vertical transport velocity of ionization in the top-side ionosphere at night. The method is applied to electron density data taken at Malvern using pulsed, incoherent scatter radar. Data from seven nights are analyzed to determine whether vertical transport of thermal plasma from the exosphere can explain the maintenance of the F region during the night. On no occasion was the downward flux sufficient and on all but one occasion the downward flux was too small by an order of magnitude. It would appear that the maintenance of the F region at night cannot be explained solely in terms of downward flux. (auth)

19336 AURORAL CONJUGACY BETWEEN KERGUELEN ISLAND AND NORTH-WEST USSR. Fehrenbach, M. (I. A. P., Paris); Weill, G.; Roldugin, V. K.; Starkov, G. V.; Vasilkova, E. A. J. Atmos. Terrest. Phys.; 36: No. 3, 407-516(Mar 1974).

During the magnetospheric substorms of 25 February 1971, simultaneous auroras occurred over Kerguelen, Heard Island and north-west U.S.S.R. The records are studied with a view to determine auroral conjugacy between these areas. Latitude wise, mean auroral conjugates in the Kerguelen, Sogra-Karpagor region are within 50 km of the nominal conjugacy after the J. C. Cain field model 1966. During the course of the substorm, variations of the conjugacy within ± 50 km occurred. Longitude-wise, the departure of auroral conjugacy from nominal magnetic conjugacy may be much larger, but could not be determined. (auth)

19337 THEORETICAL PREDICTION OF ION PLASMA OSCILLATIONS IN A NEUTRAL SHEET. Bowers, E. C. (Imperial Coll. of Science and Tech., London). Astrophys. Space Sci.; 21: No. 2, 399-423(Apr 1973).

Starting from the Vlasov equation the steady state and stability properties of the electron sheet in the Cowley neutral sheet model of the geomagnetic tail are considered. Electrostatic ion plasma oscillations propagating from dusk to dawn are found to be unstable provided the thermal spread normal to the current is sufficiently large. Assuming the population of the neutral sheet to be supplied by the polar wind it is shown how a localization of the cross tail electric field could lead to the instability first appearing around midnight. It is conjectured that the localization of the cross tail electric field could continually feed the instability, so leading to enough turbulence to give enhanced reconnection of the magnetic field. (auth)

Magnetospheric Phenomena

Refer also to abstracts 19207, 19260, and 19261.

19338 MAGNETOTAIL AND SUBSTORMS. Russell, C. T.; McPherron, R. L. (Univ. of California, Los Angeles). Space Sci. Rev.; 15: No. 2/3, 205-266(1973).

The tail plays a very active and important role in substorms. Magnetic flux eroded from the dayside magnetosphere is stored here. As more and more flux is transported to the magnetotail and stored, the boundary of the tail flares more, the field strength in the tail increases, and the currents strengthen and move closer to the Earth. Further, the plasma sheet thins and the magnetic flux crossing the neutral sheet lessens. At the onset of the expansion phase, the stored magnetic flux is returned from the tail and energy is deposited in the magnetosphere and ionosphere. During

the expansion phase of isolated substorms, the flaring angle and the lobe field strength decrease, the plasma sheet thickens and more magnetic flux crosses the neutral sheet. In this review, the experimental evidence for these processes are discussed and a phenomenological or qualitative model of the substorm sequence is presented. In this model, the flux transport is driven by the merging of the magnetospheric and interplanetary magnetic fields. During the growth phase of substorms the merging rate on the dayside magnetosphere exceeds the reconnection rate in the neutral sheet. In order to remove the oversupply of magnetic flux in the tail, a neutral point forms in the near Earth portion of the tail. If the new reconnection rate exceeds the dayside merging rate, then an isolated substorm results. However, a situation can occur in which dayside merging and tail reconnection are in equilibrium. The observed polar cap electric field and its correlation with the interplanetary magnetic field is found to be in accord with open magnetospheric models. (auth)

19339 STUDY OF THE MAGNETOSPHERE USING ENERGETIC SOLAR PARTICLES. Morfill, G.; Scholer, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Space Sci. Rev.; 15: No. 2/3, 267-353(1973).

A review is presented of the study of the magnetosphere using energetic solar particles. After a historical introduction, present knowledge about the geomagnetic field topology is briefly described in order to assess the contribution, which energetic particle measurements can make towards the study of the magnetosphere. The following historical review of satellite observations is discussed in terms of their contributions to a phenomenological classification of polar cap structures. Subsequent to about 1969 detailed trajectory calculations of particles in model magnetospheric fields were available which could be used in the interpretation of the measurements so that a strict historical treatment is not tractable. After a short description of the trajectory calculation method in various model magnetospheric fields the role of different interplanetary conditions in determining intensity structures in the geomagnetic tail and over the polar caps is discussed. Firstly, polar cap observations during different interplanetary conditions are described in terms of their contribution to the understanding of the magnetospheric topology, and secondly, observations in the distant magnetosphere and magnetotail are reported and compared with relevant theory. (auth)

19340 PARALLEL HIGH β SHOCKS AND RELAXATION PHENOMENA. Auer, R. D.; Voelk, H. J. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Astrophys. Space Sci.; 22: No. 2, 243-266(Jun 1973).

The structure of collisionless shocks propagating parallel to the magnetic field is discussed in the case of a large ratio of plasma pressure to magnetic pressure. The theory makes use of the basic ideas of Kennel and Sagdeev and it is shown that their shock model is to be interpreted in terms of relaxation shocks. The calculations are based on a purely macroscopic set of equations including finite Larmor radius effects. The resulting shock structure is determined both in a quasi-linear WKB-type approximation and through a direct numerical integration of the basic nonlinear equations. The results from both methods agree fairly well, although the level of the turbulence is high. It is argued that strong parallel shocks have a double structure, where the main transition is followed by a broad relaxation wave. It is suggested that the magnetosheath should be considered as the relaxation zone of the Earth's bow shock. (auth)

19341 ELECTROSTATIC WAVES WITH FREQUENCIES EXCEEDING THE GYROFREQUENCY IN THE MAGNETOSPHERE. Karpman, V. I.; Alekhin, Yu. K.; Borisov, N. D.; Ryabova, N. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Astrophys. Space Sci.; 22: No. 2, 267-278(Jun 1973).

Electrostatic waves with $\omega > \omega_c$ in a plasma with temperature anisotropy and loss-cone are considered. An analytical asymptotic analysis is made for waves propagating nearly perpendicular to the magnetic field and having wavelength small compared with the Larmor radius. Numerical computations are done for carried out waves with arbitrary direction of propagation. The frequency range of instability, growth damping rates, and dispersion curves have been found. The results can be used for the interpretation of magnetospheric experiments. (auth)

19342 COMPUTATION OF MAGNETIC EFFECTS OF FIELD-ALIGNED MAGNETOSPHERIC CURRENTS. Richmond, A. D. (Univ. of California, Los Angeles). J. Atmos. Terrest. Phys.; 36: No. 2, 245-252(Feb 1974).

A general method of computing ground level magnetic effects due to large-scale three-dimensional current systems external to the Earth's surface is developed. This method is particularly suitable for field-aligned magnetospheric currents which have their source in the ionospheric dynamo region. The method has been applied successfully elsewhere (Schieldge et al., J. Atmos. Terr. Phys.; 35: 1045(1973)) to the problem of antisymmetric Sq variations. (auth)

19343 ROLE OF FLUCTUATIONS IN THE INTERPLANETARY MAGNETIC FIELD IN DETERMINING THE MAGNITUDE OF SUBSTORM ACTIVITY. Garrett, H. B. (Rice Univ., Houston, TX). Planet. Space Sci.; 22: No. 1, 111-119(Jan 1974).

When hourly averages of interplanetary magnetic-field parameters are compared to the AE index, it is found that, although the time-integral of the southward component is important in determining whether there will be a substorm, the magnitude of storm activity as measured by AE is related to the level of the variance of the field. For a given value of the time-integral of the southward component of the interplanetary magnetic field, the AE index increases as the variance increases. For periods immediately following storm sudden commencements, this simple relationship apparently breaks down indicating that a different triggering process or storm-generation mechanism may be at work. These observations imply that although it is impossible to differentiate between substorms at the Earth's surface, it may be possible to differentiate between the conditions in the solar wind that lead to a certain magnitude of magnetic activity. (auth)

19344 CRITIQUE OF FLUID THEORY OF MAGNETOSPHERIC PHENOMENA. Heikkila, W. J. (Univ. of Texas, Dallas). Astrophys. Space Sci.; 23: No. 2, 261-268(Aug 1973).

It is pointed out that the fluid theory has been successful in magnetospheric problems (such as the shape of the magnetopause) which involve basic considerations such as the conservation of particles, of momentum, and of energy, but that it is inadequate for other problems (such as the energization of auroral particles). Difficulties arise from the fact that it is not always possible to specify a volume of plasma because particles do not remain as neighbors. Misuse of the fluid theory has led to a number of fallacies, such as the idea that the causal order of physical events in cosmic electrodynamics is the reverse of that in the familiar laboratory electrodynamics. This mistaken idea comes from a confusion of a mathematical sequence of calculations with the causal order. Also, the importance of the magnetic field as an active element is over-emphasized. Appreciation of the fact that kinetic theory is the more fundamental seems to be widely lacking. A plea is made for a common sense approach to magnetospheric and auroral problems wherein the fluid theory is used whenever it can, but where it is not expected to be adequate for all purposes. (auth)

19345 GENERATION AND AMPLIFICATION OF HM EMISSIONS BY ION-CYCLOTRON INSTABILITIES. Singh, S. N.; Prasad, R. Y. (Banaras Hindu Univ., India). Astrophys. Space Sci.; 23: No. 2, 269-273(Aug 1973).

This paper describes the analysis of the growth rate of hydromagnetic waves in the magnetosphere in ion-cyclotron mode considering multicomponent thermal plasma. Effects upon growth rate have been estimated due to (a) thermal velocity of background plasma; (b) presence of helium ions in background plasma; (c) beam velocity; (d) beam density. (auth)

19346 NONLINEAR MAGNETOSONIC WAVES PROPAGATING PERPENDICULAR TO A MAGNETIC NEUTRAL SHEET. Sakai, J. I. (Nagoya Univ., Japan). Astrophys. Space Sci.; 23: No. 2, 285-300(Aug 1973).

Nonlinear magnetosonic waves propagating in a magnetic neutral sheet were investigated within the framework of a fluid model. It is shown that the behavior of the magnetosonic waves is governed by a "modified Burgers equation" with an additional term $c(\eta)\phi$ due to the relevant slowly varying background plasma parameter (density or magnetic field). When fast magnetosonic waves propagating toward the neutral region across the magnetic field are considered, they grow and undergo rapid steepening after passing through the neutral region; i.e., shock formation is promoted by the background inhomogeneity. By numerical computation, the time evolution was examined for two initial disturbances, the pulse type (gaussian) and the wave train type (sinusoidal wave). The relevance of the interactions between the magnetosonic shock waves and the neutral sheet plasma to a triggering mechanism of sympathetic flares is also suggested. (auth)

19347 COMMENTS ON THE PAPER "INTERPLANETARY ORIGIN OF ELECTRIC FIELDS IN THE MAGNETOSPHERE" BY A. NISHIDA. Kawasaki, K. (Univ. of Alaska, Fairbanks). Astrophys. Space Sci.; 24: No. 2, 449-457(Oct 1973).

In a recent paper (Nishida, 1971b), the response of the magnetosphere as indicated by the AE index to southward-turnings of the interplanetary magnetic field was investigated. The southward-turnings were classified according to magnitude and duration. It

is demonstrated that at least in some of the examples shown in the paper, the AE indexes, against which the southward-turnings were compared, were incomplete, requiring modification of some of the conclusions in Nishida (1971b). A reply by Nishida is included. (WDM)

19348 SHORT WAVELENGTH INSTABILITY IN THE NEUTRAL SHEET OF THE EARTH'S GEOMAGNETIC TAIL. Bowers, E. C. (Imperial Coll. of Science and Tech., London). Astrophys. Space Sci.; 24: No. 2, 349-369(Oct 1973).

In an earlier paper, Bowers (1973), ion plasma oscillations were found to be unstable in the steady state developed by Cowley (1972) for the neutral sheet in the Earth's geomagnetic tail. In this paper a similar stability analysis is carried out but for a different steady state, suggested by Dungey, with the result that unstable waves with frequencies near the electron plasma frequency are found. In the Dungey steady state the current necessary for magnetic field reversal is carried by plasma originating from both the magnetosheath and the lobes of the tail. This modifies the steady state proposed by Alfvén and subsequently developed by Cowley in which all the current is carried by plasma from the lobes of the tail thereby fixing the cross-tail potential Φ. With magnetosheath plasma present the value of Φ is no longer fixed solely by parameters in the lobes of the tail but the cross-tail electric field is still assumed localized in the dusk region of the sheet as in the Cowley model due to the balance of charge required in the neutral sheet. The value of Φ can be expected to increase as magnetic flux is transported to the tail which inflates and causes flux annihilation because the magnetosheath plasma in the neutral sheet has insufficient pressure to keep the two lobes of the tail apart. The Vlasov–Maxwell set of equations is perturbed and linearized enabling a critical condition for instability to be found for modes propagating across the tail. Typically, this condition requires $e\Phi \geq KT_m$ where T_m is the temperature of magnetosheath electrons. The instability occurs in the presence of cold plasma which has $E \times B$ drifted into the neutral sheet from the lobes of the tail. This contrasts with the usual two stream instability which is stabilized by the cold plasma. Once precipitated the instability may be explosive provided current disruption occurs, for then a further increase in Φ will result which drives a greater range of wave numbers unstable thereby causing even more turbulence and an even larger cross-tail electric field. Because of this behavior the instability may be a trigger for a substorm. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 18756–18764, 18766, 18769, and 18771.

19349 FIELD THEORETIC APPROACH TO 1S-2S EXCITATION IN He COLLISION AT LOW ENERGY. Roy, T.; Bhattacharyya, S. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 9: No. 2, 54-58 (12 Jan 1974).

The differential cross sections for the 1S-2S excitation of the hydrogen atom by low-energy electrons were calculated in lowest-order approximation from the viewpoint of field theory for bound states in quantum electrodynamics. The result is found to be in fair agreement with experimental curves of Stebbings et al. (Phys. Rev. 119, 1939 (1960)). (LBS)

19350 REFLECTION OF ^{4}He ATOMIC BEAMS FROM CLEAN LiF SURFACES. Houston, D. E.; Frankl, D. R. (Pennsylvania State Univ., University Park). Phys. Rev. Lett.; 31: No. 5, 298-300(30 Jul 1973).

Reflection of a ^{4}He nozzle beam from a LiF crystal surface cleaved in situ at 10^{-9} Torr was studied. As compared with previous results on water-covered surfaces, the selective adsorption intensity minima are pronouncedly sharpened and deepened and there is considerable fine structure. The main minima can be associated with three bound states and two positive-energy resonances. On aging the surface in the vacuum, the fine structure fades and the bound-state energy levels shift slightly. (auth)

19351 ELECTRON AFFINITIES OF SOME ELEMENTS. Feldmann, D. (Univ., Hamburg); Rackwitz, R.; Heinicke, E.; Kaiser, H. J. Phys. Lett.; 45A: No. 5, 404(22 Oct 1973).

Photodetachment cross sections of several atomic negative ions were measured in order to supply a fairly complete set of experimental values for the electron affinity of the elements of the short periods. (auth)

19352 OBSERVATION OF MULTIPLE PEAKING AND A POSSIBLE ENHANCED DIFFUSION EFFECT IN CHANNELLING ANGULAR DISTRIBUTIONS. Alexander, R. B.; Callaghan, P. T. (Clarendon Lab., Oxford). Phys. Lett.; 45A: No. 5, 379-380(22 Oct 1973).

Multiple peaking was observed in a channelling angular distribution obtained with N ions back-scattered from a Br-implanted Fe single crystal. An effect associated with the same distribution is seen which is attributed to the enhanced diffusion of N in Fe. (auth)

19353 ION IMPLANTATION: MEASUREMENT OF ION PRESSURE. Hlavka, J. (Univ., Brno). Phys. Lett.; 45A: No. 5, 407-408(22 Oct 1973).

The paper deals with a simple technique of measurement of ion pressure which is created when accelerated ions strike a solid target. (auth)

19354 EXCITATION OF A CYLINDER HAVING A LONGITUDINAL SLIT BY A PLANE MODULATED STREAM OF CHARGED PARTICLES. Koshpar'onok, V. M.; Sidorenko, E. B. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 23-26(1972). (In Russian).

A solution is obtained to the problem of exciting electromagnetic oscillations inside and behind a cylinder having a longitudinal slit by a plane modulated stream striking the cylinder in such a way that the slit can be arbitrarily orientated with respect to the particle stream. The solution is presented in the form of a Fourier–Bessel series whose coefficients are formed from the strictly limiting problem by the Riemann–Gilbert method. The solution includes a large number of parametric changes, and assumes the availability of a computer. (tr-auth)

19355 PRODUCTION OF INTENSE ATOMIC BEAMS. Lucas, C. B. (Univ. of York, Eng.). Vacuum; 23: No. 11, 395-402(Nov 1973).

Methods of producing multichannel capillary arrays in various materials for use as atomic beam forming devices are reviewed. The advantages of gas focusing arrays are considered. The theories of the flow of gas through a cylindrical tube are discussed. Completely general numerical and graphical results derived from Zugenmaier's theory (Z. Angew. Phys.; 20: 184(1966)) are presented. Their use in designing gas beam systems is described. Data are presented in a convenient form for the experimentalist. Comparison of the numerical results with published experimental data is made. It is shown that, for most purposes, a capillary is best operated at an input pressure giving a mean free path which is less than 10% of the tube length. In an array, it is an advantage to have tubes of small diameter. With a focusing array, beam densities of up to 10^{14} atoms cm^{-3} are predicted when the beam half width is 1°. (auth)

19356 ENERGY SPECTRA OF HELIUM IONS SCATTERED FROM THE (100) PbS SURFACE. Matsevich, V. G.; Zyryanov, G. K. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 1, 254-260(Jan 1974). (In Russian).

The energy spectra of ions scattered from the (100) PbS surface bombarded by helium ions with energies up to 1 keV are obtained by the electrical differentiation method. It is found that the binary collision model is valid for primary ion energies of about 100 eV or higher. Carbon and oxygen atoms on the (100) PbS surface are detected by elemental analysis. (auth)

19357 CONTROL OF INSTABILITY DEVELOPMENT IN MULTIBEAM SYSTEMS. Fedorchenko, V. D.; Mazalov, Yu. P.; Bakai, A. S.; Rutkevich, B. N. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2225-2235(Dec 1973). (In Russian).

The development of instability in multibeam systems is studied experimentally and theoretically. It is shown that in the linear stage the mutual effect of electron beams is comparatively weak and leads to some changes in the unstable mode increments. The nonlinear stage, in which capture of resonance particles occurs and growth of the amplitudes is limited, is very sensitive to changes in the initial velocities and density of the beams. This permits one to control the development of instability and to alter the intensity of the excited oscillations in a broad range, the mean plasma parameters and the total current remaining practically unchanged. (auth)

19358 SELF-CONSISTENT SPACE-CHARGE-FLOW USING INTEGRAL EQUATION FIELD METHODS. Kusic, G. L. (Univ. of Pittsburgh). J. Comput. Phys.; 13: No. 4, 551-568(Dec 1973).

Integral equations are used to calculate ion beams in a self-consistent space-charge-flow simulation. A charge-free solution is found, then an iterative process is used to determine new fields and the distribution of charge within the domain. Child's law is assumed to describe ion emission in the region of the emitter, and the remaining distribution is found by correlating trajectories representative of ions within the beam. Integral equations lead to a straightforward formulation for the charge density immediately in front of the ion-emitter in terms of the potentials for these locations which were obtained in the previous iteration. Advantages of the integral equation approach are that field equations need be solved one time only and subsequent iterated values of the field for updated charge estimates are found by a matrix multiplication. In addition, the gradient values needed to calculate the trajectories are in analytical form. An example of a planar election flow gun is used to demonstrate the approach used. (auth)

19359 SIMPLE, CHEAP, UNIVERSAL ION SOURCE. Jensen, K.; Veje, E. (Univ. of Copenhagen). Nucl. Instrum. Methods; 115: No. 1, 307-308(1974).

A simple, cheap, universal ion source has been constructed. Beam currents of doubly charged ions are generally around 10% of the corresponding currents of singly charged species. (auth)

19360 SCATTERING FROM A RANDOM ROUGH SURFACE: DIAGRAM METHODS FOR ELASTIC MEDIA. DeSanto, J. A. (Naval Research Lab., Washington, DC). J. Math. Phys. (N. Y.); 14: No. 11, 1566-1573(Nov 1973).

In a previous paper [J. Math. Phys. 13, 1903 (1972)], Feynman diagram methods were used to construct the Green's function and its first two moments for scalar wave scattering from a random rough surface with a Neumann boundary condition. These formal diagram methods are extended to the calculation of the Green's function and its first two moments for an elastic half-space bounded by a random rough surface considered as a free boundary. The surface height is a single valued bounded function with Gaussian statistics. The Dyson and Bethe–Salpeter equations, for the mean and second moment respectively, of the Green's function, are derived. Some simplifications of these integral equations and some examples are presented. (auth)

Atomic and Molecular Properties

Refer also to abstracts 19579 and 20564.

19361 (ITEF-19) COHERENT ENERGIZING BY A CRYSTAL PERIODIC FIELD. Okorokov, V. V.; Tolchenkov, D. L.; Cheblukov, Yu. N.; Khizhnyakov, I. S.; Lapitskii, Yu. Ya.; Iferov, G. A.;

Zhukova, Yu. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 44p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

The experimental results confirming the existence of the effect of coherent energizing of ion levels of He^+ passing through crystals were reported. The effect of the slowing down of the particle in the crystal and of the thermal oscillation of the crystal atom on the possibility of observing coherent energizing of atomic and nuclear levels was examined. Qualitative consideration on some physical possibilities of the effect was given. (tr-auth)

19362 (NP-19939, pp 76-78) SHIELDING OF CRYSTALLINE ELECTRIC FIELD IN PRASEODYMIUM COMPOUNDS. Das, K. C.; Raychaudhuri, A. K. 1971.

19363 OPTICAL ISOTOPE SHIFTS IN NEODYMIUM. King, W. H. (Newcastle upon Tyne Univ., Eng.); Steudel, A.; Wilson, M. Z. Phys.; 265: No. 3, 207-224(Nov 1973).

Isotope shifts were measured in Nd II from which the shifts between pure configurations $4f^46s$ and $4f^45d$ can be determined. The specific mass shift for such a "transition" was estimated to be +3 mK for a change of two neutrons. By comparison with electronic x-ray isotope shifts values were obtained for the change in the nuclear charge distribution. Field shifts in several optical transitions were compared with values of $\chi(0)/^2$ obtained from Hartree-Fock wave functions; agreement is good. Other specific mass shifts were estimated $4f^46s-4f^46p$, -1 mK; $4f^46s-4f^35d^2$, -30 mK. These values are in good agreement with calculated values of -1.1 and -30.6 mK. (GE)

19364 MEASUREMENT OF L SUBSHELL YIELDS OF La BY MEANS OF COINCIDENCE AND CRITICAL ABSORPTION. Douglas, D. G. (Univ. of Manitoba, Winnipeg). Can. J. Phys.; 51: No. 14, 1519-1523(15 Jul 1973).

The L subshell yields ω_2, ω_3, and f_{23} were measured for Z = 57 by observation of the x rays of ^{139}Ce employing a method combining coincidence and critical absorption. The results for $\omega_2(0.112 \pm 0.009)$ and $\omega_3(0.092 \pm 0.008)$ are in fairly satisfactory agreement with theory but $f_{23}(0.21 \pm 0.02)$, as was shown to be the case at other Z values, exceeds theoretical predictions. (auth)

19365 SOME HELIUM AUTOIONIZATION STATES AND THE STABILIZATION METHOD. Eliezer, I.; Moualem, A. (Tel Aviv Univ., Israel). J. Chem. Soc., Faraday Trans., II; 69: No. 12, 1835-1838(1973).

The possible application of the MO variational method used for calculations of resonance state energies in He^- and H_2^- is examined for the case of resonance states of two-electron atoms. As an illustration, the energies of the first three $^1P^0$ resonance states of He are calculated and the results discussed. (auth)

19366 SIX-PARAMETER CALCULATION OF THE 1^1S STATE OF HELIUM. Esquivel, J. L.; De Teramond, G. F. (Univ., Costa Rica, San Jose). Phys. Lett.; 46A: No. 4, 297-298(31 Dec 1973).

A variational calculation for the ground state of helium is carried out with a six parameter wave function including the factor $\exp(-\alpha r_{12})$. The energy obtained is -2.90346 a.u. compared to Hylleraas six parameter value -2.90324 a.u. (auth)

19367 ROLES OF ELASTIC AND INELASTIC ELECTRON COLLISIONS IN THE BROADENING OF HYDROGEN LINES. Griem, H. R. (Univ. of Maryland, College Park). Comments At. Mol. Phys.; 4: No. 3, 75-83(1973).

The question of the inclusion of inelastic collisions causing transitions between Stark-split sublevels of the same principal quantum number n in the interference term between, say, the n = 2 and n = 3 levels of hydrogen broadened by electrons and ions in a plasma is discussed. As a rule, inelastic collisions in this sense should not be included, except for portions of the line that are removed from line center by more than the electron plasma frequency. (auth)

19368 VARIATIONAL CALCULATION OF THE POSITRON-HELIUM BOUND STATE. Moussa, A. H.; Radi, H. M. A. (Kuwait Univ.). Physica; 69: No. 2, 587-597(1 Nov 1973).

A Rayleigh-Ritz variational calculation, to investigate the possibility of existence of a positron-helium bound state, is carried out using 9 different trial functions containing parameters of which the number varies from 4 to 18. The results indicate that the positron does not get bound to a helium atom. This disagrees with a similar calculation using 4 parameters, and agrees with an adiabatic approximation for conditions of existence of bound states. The same procedure is applied to the helium atom and the results for two wave functions and ground-state energies are given. (auth)

19369 SOLUTION OF SCHROEDINGER'S EQUATION FOR TWO-ELECTRON SYSTEMS BY AN MCHF PROCEDURE. Fischer, C. F. (Univ. of Waterloo, Ont.). J. Comput. Phys.; 13: No. 4, 502-521(Dec 1973).

Assuming the existence of a complete set of orthonormal radial functions $\{P_{nl}(r), n = l + 1, \ldots\}, l = 0, 1, \ldots$ and an expansion of the exact total wave function for a two-electron system, it is shown that orthogonal transformations of the radial functions exist so that the expression can be reduced from a triple to a double sum. The exact form depends on the symmetry of the state. A procedure is proposed for solving Schroedinger's equation using an MCHF approach to the reduced form. Convergence of the process is illustrated for the $1s^2{}^1S$, $1s2s^{1,3}S$, and $1s2p^{1,3}P$ states of He using numerical methods. (auth)

19370 ELECTRONIC STATES IN DISORDERED SYSTEMS. Halperin, B. I. (Bell Telephone Labs, Inc., Murray Hill, NJ). Phys. Fenn.; 8: No. 2-3, 215-251(1973).

A survey is presented of concepts in the theory of electronic states in disordered systems. Topics covered include the distinction between localized and extended states, transport properties of localized states, perturbation calculations for weak scattering, estimation of the density of states in an energy-band tail, and applications to the mobility transition of an electron in helium gas. (auth)

19371 STERNHEIMER SHIELDING-ANTISHIELDING. II. Gupta, R. P.; Sen, S. K. (Univ. of Manitoba, Winnipeg). Phys. Rev., A; 8: No. 3, 1169-1172(Sep 1973).

The Sternheimer shielding-antishielding parameters are reported for 77 ions in 3d, 4d, 5d, and 5f groups, as well as for gold and lithium atoms. The parameters λ and R, which take into account, respectively, the effect of the core electrons on the quadrupole perturbing potential outside the ion and within the ion (owing to unfilled valence-shell electrons), were calculated for varying ionic charge and varying atomic number in each group. The electronic wave functions used throughout the work are of the nonrelativistic Hartree-Fock-Slater type. Interesting differences of the results in each group are seen to be the values of Sternheimer parameters and α_q for ions with and without the closed-shell configurations. Also, for the lithium atom with $1s^22p^1$ configuration $1 - \lambda_2 = 3.46$ is obtained assuming $2p^1$-shell perturbation to be one-sixth that of the closed p shell. This value, incidentally, is the same as that measured recently by Anderson and Karra for the lithium ion (Li^+) in LiF. For gold atoms the configurations $5d^{10}6p^1$ and $5d^{10}6s^1$ were considered and the ratios of atomic core $5p_{\frac{3}{2}}$ to $4p_{\frac{3}{2}}$ energy-level splittings were obtained as 1.6 and 1.7, respectively, against approximately 2 determined experimentally by Novakov and Hollander for Au in gold-cyanide compounds. The significance of these calculations is emphasized by the possibility of experimentally determining the quadrupole splittings of the atomic core by high resolution electron spectroscopy. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 19368 and 19612.

19372 (KFKI-73-53) SIMULTANEOUS PARAMETER ESTIMATION IN THE ILL-CONDITIONED LEAST-SQUARES FITTING PROBLEM. Horvath, D. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

In ill-conditioned fitting problems the results of other measurements can be accounted as independently measured points if the sum-of-squares to be minimized is completed with a term of type $\sum_{j,k=1}^{p} [Q^{-1}]_{jk} \cdot (b_j - \bar{b}_j)(b_k - \bar{b}_k)$ where Q_b is the covariance matrix of parameter vector b estimated by other measurements. The practical performance of the modified minimization is shown for the case of Gauss-Newton method of nonlinear least-squares fitting, and it is illustrated by the evaluation of positron lifetime measurements. (auth)

19373 MEASUREMENT OF THE RATE OF MUON CAPTURE IN GASEOUS HYDROGEN. Bystritskii, V. M.; Dzhelepov, V. P.; Ermolov, P. F.; Oganesyan, K. O.; Omel'yanenko, M. N.; Porokhovoi, S. Yu.; Roganov, V. S.; Rudenko, A. I.; Fil'chenkov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 1, 43-60(Jan 1974). (In Russian).

Muon capture by protons is investigated by employing a gaseous hydrogen target and the Dubna synchrocyclotron muon beam. There were 278 ± 33 events of this type recorded. The measured capture rate is $\lambda_{capt}^{pp} = 686 \pm 88\ sec^{-1}$. The result obtained is in accordance with predictions of the universal four-fermion interaction theory and is a definite argument in favor of the V-A variant of the theory. (auth)

19374 ESOTERIC ATOMIC PROCESSES. Pichanick, F. M. I. (Univ. of Massachusetts, Amherst). Comments At. Mol. Phys.; 4: No. 3, 69-74(1973).

From fourth annual meeting of the Division of Electron and Atomic Physics; Menlo Park, CA (29 Nov 1972).

A summary of some topics discussed at the 1972 meeting of the Division of Electron and Atomic Physics of the American Physical Society is given, together with some recent related developments. These topics include: muonic atoms; kaonic atoms; antiatomic physics; and quantum electrodynamics in superheavy elements. (UK)

19375 MOLECULAR STRUCTURE EFFECTS ON ATOMIC AND NUCLEAR CAPTURE OF MESONS. Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Annu. Rev. Nucl. Sci.; 23: 395-430(1973).

A review is given of the experimental studies in which the effects of the chemical nature of matter on the meson capture processes are detected and analyzed. Some theoretical ideas currently used for the analysis of the experimental results are also given. (JFP)

19376 MUONIUM. Gillespie, E. S. (Ulster Coll., Newtonabbey, Northern Ireland). Phys. Educ.; 9: No. 1, 34-36 (Jan 1974).

Comparison is made, as regards reactions, between the muonium, which consists of a positive muon and an electron, and the hydrogen atom. Methods of measuring collision cross sections using the phenomenon of nonconservation of parity in the production and decay of the muon are considered. The energy states and hyperfine structure of the muonium are discussed and how its interactions with gas molecules are observed using a modification of the technique employed to discover muonium by Hughes et al. (Phys. Rev. Lett.; 5: 63 (1960)) is described. (UK)

19377 FORMATION OF MUONIUM IN FAST COLLISIONS OF μ^+ MESONS WITH ATOMIC SYSTEMS. Belkic, D. S.; Janev, R. K. (Inst. of Physics, Belgrade). J. Phys., B (London); 6: No. 12, 2613-2617(Dec 1973).

The process of muonium (μ^+,e) formation by electron capture mechanism in collisions of positive mesons with atomic systems is considered at high energies. The continuum distorted wave (CDW) method is used for calculation of the cross sections for μ^+-H and μ^+-He electron capture reactions from 10 keV to 1 MeV. The calculated cross sections are compared with those for electron capture from the same atomic systems by protons. (auth)

19378 DIFFERENCES IN THE ANNIHILATION OF POSITRONS IN OPTICAL ISOMERS. Garay, A. S. (Biological Research Center, Szeged); Keszthelyi, L.; Demeter, I.; Hrasko, P. Chem. Phys. Lett.; 23: No. 4, 549-552(15 Dec 1973).

Differences were observed in the lifetime spectra of positron annihilation in L and D isomers of some amino acids. The intensity of the triplet component was found to be greater in D isomers than in L isomers. Two possible explanations are discussed. (auth)

Collision Phenomena

Refer also to abstracts 18168, 19367, and 19400.

19379 (LBL-2253) MOLECULAR BEAM STUDIES OF ELECTRONIC ENERGY TRANSFER PROCESSES WITH METASTABLE MERCURY ATOMS. Loh, L. C. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1974. Contract W-7405-eng-48. 122p. Dep. NTIS $8.25.

Thesis.

An apparatus was constructed to study electronic energy transfer processes with metastable mercury atoms using the molecular beam technique. The study involves crossing a beam of metastable 6^3P_0 and 6^3P_2 mercury atoms with a velocity selected beam of thallium atoms or alkali halide molecules. The photon emission from the excited thallium atoms produced in the former and the excited alkali atoms in the latter is detected at the collision zone by a photomultiplier. A method is developed to extract the velocity dependence of the relative cross section from the experimental data. For the $Hg^* + Tl$ system, quantitative information was obtained for the excitation of thallium 5350Å line fluorescence. The relative cross section was found to be a monotonically decreasing function of velocity g with a g^{-2} dependence. An ionic curve crossing model was suggested as one possible way of explaining this dependence. Lithium iodide, sodium iodide and sodium bromide were selected for study in the experiments with alkali halides. Quantitative results were reported for the last two. The relative cross sections have g^{-3} and $g^{-3.6}$ dependences for NaI and NaBr respectively. The results could possibly be explained by a statistical model. (auth)

19380 APPROACH TO IONIZATION EQUILIBRIUM AND ATOMIC COLLISION CROSS-SECTION MEASUREMENT IN A HELIUM SHOCK WAVE. Kalra, S. P.; Measures, R. M. (Univ. of Toronto). Can. J. Phys.; 51: No. 18, 1956-1964(15 Sep 1973).

A theoretical and experimental study of the initial ionization phase of an ionizing helium shock wave was accomplished. Ionization relaxation time and the electron density profile behind the shock translational front were measured. Both of these parameters have strong dependence upon the atomic collisional excitation rate in the initial phase of the ionizing shock wave, and therefore, a comparison with theory led to an estimation of the atom–atom collisional excitation cross section. Theoretical predictions for the relaxation zone of the helium shock wave indicated only a weak coupling between the electron and atom temperature during the relaxation process. A plasma focus driven shock tube was used to create the appropriate helium shock waves. Simultaneous measurement of the relaxation time and the electron density profile was performed using a multipass Fabry–Perot laser interferometer. A close agreement between the theoretical and the experimental temporal electron density profile was obtained with the experimental conditions (pressure $P_\infty = 0.5$ to 5 torr, shock Mach number 16 to 26). The effective cross section for atom–atom excitation close to threshold is $\approx 2 \times 10^{-19}$ cm^2. (auth)

19381 PHASE SHIFT ANALYSIS AND CONSISTENCY CHECKS ON ELECTRON–ATOM COLLISION DATA. Naccache, P. F.; McDowell, M. R. C. (Royal Holloway Coll., Englefield Green, Eng.). Comput. Phys. Commun.; 6: No. 2, 77-87(Aug 1973).

The program SHIFTA written in FORTRAN IV for the CDC 6600 is described for testing the consistency of different sets of experimental measurements of electron–atom scattering below the first inelastic threshold and indicates the relative merit of each measurement. The program produces a set of parameters which give values of the first l_0 phase shifts (subject to certain specified constraints) consistent with the data. (JFP)

19382 CROSS SECTIONS FOR K-SHELL IONIZATION BY ^1H, ^2H, ^3He, AND ^4He ION IMPACT. Rutledge, C. H.; Watson, R. L. (Texas A and M Univ., College Station). At. Data Nucl. Data Tables; 12: No. 2, 195-216(Sep 1973).

Cross sections for K-shell ionization derived from experimental measurements with the light ions ^1H, ^2H, ^3He, and ^4He are tabulated according to projectile energy and target atomic number. (4 tables) (auth)

19383 ROLE OF MASS AND STRUCTURE OF ELECTRON SHELLS OF BOMBARDING PARTICLES IN THE KINETIC SECONDARY ELECTRON EMISSION. Khashimov, N. M. Dokl. Akad. Nauk Tadzh. SSR; 16: No. 9, 25-29(1973). (In Russian).

The experimental results obtained show that the kinetic ion-electron emission basically depends on the velocity and mass of the bombarding particles. The structure of the electron shells of these particles and their charge state does not have a substantial effect on the size of the ion-electron emission coefficient. (tr-auth)

19384 ELECTRON SPECTROSCOPY OF AUTOIONIZING STATES OF NOBLE GASES. Cermak, V.; Smutek, M.; Sramek, J. (Inst. of Physical Chemistry and Electrochemistry, Prague). J. Electron Spectros. Relat. Phenomena; 2: No. 1, 1-12(Jul 1973).

A high resolution electron spectroscopy technique is used to study the autoionization of noble gases excited by fast neutral noble gas atoms with 80 to 600 eV kinetic energy. The energy and notation of the excited states is determined by considering the proper quantum defects in the Rydberg series. The double excited states prevail over the singly excited ones. Like and unlike colliding pairs are studied and various excitation processes are suggested for the He-Kr, Ar-Kr and Ar-Xe systems. (auth)

19385 EFFECT OF TRANSFER OF EXCITATION ON RESONANCE BROADENING. Cooper, J. (Univ. of Colorado, Boulder); Stacey, D. N. Phys. Lett.; 46A: No. 4, 299-300(31 Dec 1973).

The shift of a resonance line due to the coherent transfer of excitation in collisions is evaluated for several combinations of ground and excited level angular momenta. The Doppler effect is shown to reduce these shifts at low pressures. (auth)

19386 TRANSITIONS BETWEEN DEGENERATE STATES OF EXCITED HYDROGEN–LIKE IONS IN DISTANT COLLISIONS WITH CHARGED PARTICLES. Demkov, Yu. N.; Ostrovskii, V. N.; Solov'ev, E. A. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 1, 125-134(Jan 1974). (In Russian).

Transitions between n^2 degenerate states of an excited hydrogen-like ion (n is the principal quantum number) is considered for distant collisions between the ion and a heavy charged particle. The nuclei are assumed to move along classical trajectories, the interaction between them at large distances being close to Coulomb interaction. The nonstationary Schroedinger equation for electrons

in the basis of n^2 degenerate states is solved exactly by employing the four-dimensional symmetry group for a non-relativistic hydrogen-like atom and the dipole approximation for interaction between an atomic electron and charged particle. The dynamic terms are found and also the corresponding quasi-molecule dynamic wave functions between which transitions do not occur during the collision. Interference between the states results in oscillations in the angular dependences of the transition probabilities between states with spherical quantum numbers. The limits of applicability of the theory are discussed. As an example the $H^+ + He^+$ $(2s) \rightarrow H^+ + He^+$ (2p) reaction is considered in detail. (auth)

19387 ATOM–ATOM AND ATOM–ION COLLISIONS. 4. Inelastic Collisions. Massey, H. (University Coll., London). Contemp. Phys.; 14: No. 6, 497-512(Nov 1973).

Consideration is given to certain aspects of inelastic collisions. The semi-empirical use of complex phase shifts to allow for the occurrence of such differences is first discussed and related to the concept of complex scattering potentials. Scattering by an absorbing sphere is then considered and shown to involve elastic shadow scattering. This is related to certain experimental results on the angular distribution of He^+ ions scattered by Kr and Xe atoms. Complex phase shift analysis is then extended to collisions between H and H^- in which both charge transfer and detachment may occur. A description is given of the experimental method used to measure these cross sections and of the relation of the observed results to the theory. Finally, a discussion of curve-crossing perturbations in elastic scattering and their relation to inelastic scattering is given. It is shown that these effects account for certain observed phenomena in the elastic scattering of ions by atoms which were not explicable in terms of the analysis given previously. (auth)

19388 GSI WORKING CONFERENCE, SPRING 1972. (1972). vp. (In German).

From working conference of the Gesellschaft fuer Schwerionenforschung; Darmstadt, Ger. (26 May 1972).

The following topics were emphasized; beam and target technology, nuclear reactions and atomic physics. The following 7 lectures are included; target problems in experiments with intense beams of heavy ions; application of time-of-flight methods for particle identification; formulas for the kinematics of reactions; Q-value and angular momentum windows for multi-nucleon transfer reactions; charge exchange experiments with heavy ions; quasiatoms; problems of the electrodynamics of strong fields in heavy ion scattering. (GE)

19389 NEUTRALIZATION OF FAST HELIUM IONS BY CESIUM. Montmagnon, J. L.; De Palmas, H.; Grouard, J. P.; Lefebure, P.; Mercier, E. (Univ., Paris). Phys. Lett.; 46A: No. 3, 227-228(17 Dec 1973).

The absolute cross section for charge-exchange in cesium vapor was measured for 5 to 25 keV He^+ ions. The proportion of He^* metastable triplet in the post charge-exchange beam was estimated. (auth)

19390 STRIPPING IN COLLISIONS BETWEEN HYDROGEN MOLECULES BELOW 500 eV. Peterson, R. K.; Eisner, M. (Univ. of Houston, TX). Phys. Rev., A; 8: No. 3, 1289-1302 (Sep 1973).

The cross sections for the production of forward scattered molecular ions in collisions of H_2 on H_2 and D_2 on D_2 were measured at lab kinetic energies between 50 and 500 eV. The cross section for the H_3 reaction ranges from 2.2×10^{-17} cm^2 at 500 eV to 5.0×10^{-19} cm^2 at 50 eV. The D_3 cross section varies from 1.7×10^{-17} cm^2 to 3.8×10^{-19} cm^2 in the same energy range. The angular dependence of the ions was found to be highly peaked in the forward direction for energies above 100 eV. The cross sections for H_3 and D_3, when plotted versus incident velocity, are found to approach the same values at the highest velocities. The two cross sections diverge toward lower velocities as they approach their respective cutoffs, where each process becomes energetically impossible. These cross sections were found to fit a theoretical model based on ideas first presented by Demkov and Komarov, in which ionization is presumed to take place via a series of pseudocrossings of the initial state into the continuum of the adiabatic states of the collision complex. For the interaction of two hydrogen molecules, the internuclear separation of each molecule is assumed fixed and the adiabatic states are defined in terms of the distance between the two molecular centers (R). Best agreement between the observed cross sections and those predicted from the model are obtained assuming the transition region to be centered around R = 0.43 Å, 16.5 eV above the energy of the ground state at large R. For the purpose of monitoring the neutral-beam intensity, the secondary-electron emission coefficients (γ) were measured for H_2 and D_2 impinging on a brass surface. The γ values were found to vary from 0.77 and 0.65 at 500 to 0.045 and 0.020 at 50 eV for H_2 and D_2, respectively. (auth)

19391 ANALYTIC APPROXIMATION METHOD FOR THE ONE-DIMENSIONAL SCHROEDINGER EQUATION. II. Hecht, W. (Univ., Freiburg, I. B.). J. Math. Phys. (N. Y.); 14: No. 11, 1519-1521(Nov 1973).

The problem with three classical turning points which must be solved in order to discuss "orbiting" collisions in molecular physics or "quasimolecular states" occurring in α-nucleus and heavy ion scattering is treated, using the approximation method already discussed. The general previous statement concerning complex conjugate turning points is thereby confirmed and the corresponding formulas known from Langer's method can be obtained as special cases. (auth)

19392 ELASTIC AND INELASTIC ANGULAR DISTRIBUTIONS IN THE j_z-CONSERVING COUPLED STATES APPROXIMATION FOR MOLECULAR COLLISIONS. McGuire, P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). Chem. Phys. Lett.; 23: No. 4, 575-578(15 Dec 1973).

An approximation scheme is described which allows the decoupling of molecular rotational j and l angular momenta in molecular collisions. With a particular choice of the interaction potential, the potential matrix couples only the molecular states of the system and in particular those in which the z-axis projection of j is conserved. Test calculations on He + H_2 for the elastic $j = 0 \rightarrow 0$ and rotationally inelastic $j = 0 \rightarrow 2$ differential cross sections are presented in the energy range 0.1 to 0.9 eV. These results are compared with the full coupled-channel cross sections and are found to be extremely accurate. (auth)

19393 SECOND-HARMONIC ELECTRIC QUADRUPOLAR ELASTIC SCATTERING BY ATOMS AND CENTRO-SYMMETRIC MOLECULES. Kielich, S.; Kozierowski, M.; Ozgo, Z.; Zawodny, R. (Univ., Poznan, Poland). Acta Phys. Pol.; A45: No. 1, 9-19 (Jan 1974).

Atoms and centro-symmetric molecules, for which second-harmonic elastic scattering is forbidden in the electric dipole approximation, are shown to cause double photon scattering in the electric quadrupole approximation. The process is described by a 4th rank tensor of quadrupolar polarizability $q^{2\omega}_{\beta,\kappa\lambda}$ whose nonzero and independent elements are available in tabulated form for all point groups. General formulas are derived for the light intensity components quadrupolarly scattered at 2ω as well as for their depolarization ratios, which are shown to depend on the scattering angle otherwise than in the case of electric dipole scattering. The theory is applied to atomic gases and ones with molecules of simpler symmetry. (auth)

19394 EFFECT OF TERNARY COLLISIONS IN THE PRESSURE BROADENING THEORY OF SPECTRAL LINES OF ATOMS. I. An Expansion of Relaxation Matrix into Powers of Gas Density in the Classical Path Approximation. Czuchaj, E. (Univ., Danzig). Acta Phys. Pol.; A45: No. 1, 97-118(Jan 1974).

The effect of ternary collisions in the pressure broadening of the spectral lines of atoms in the classical path approximation is investigated. In particular, it was shown that this effect can be taken into account by performing a suitable modification of the interaction potential acting between a radiator and two perturbers. This modification consists mainly of adding some term to that potential, which describes so-called nonadditive forces. Presuming that the two-particle coupling is of the dipole–dipole type, these nonadditive forces are obtained by means of third-order perturbation theory used to calculate the interaction energy of three particles. (auth)

19395 CLASSICAL SUPERPOSITION PHENOMENA IN H_2^+(upsilon = 0)–He REACTIVE COLLISIONS. North, G. R.; Leventhal, J. J. (Univ. of Missouri, St. Louis). Chem. Phys. Lett.; 23: No. 4, 600-602(15 Dec 1973).

A simple classical model is used to analyze reactive processes in H_2^+–He collisions at relative energies above a few eV. Detailed structure of the cross section occurs and is a consequence of the superposition of probabilities due to distinct binary collision mechanisms which depend on impact parameter and initial orientation. The predicted structure correlates favorably with available experimental data. Comparison is also made with the (quantum) statistical phase space model. (auth)

19396 VIRIAL THEOREM FOR ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY HELIUM. McWhirter, J. D. G.; Moiseiwitsch, B. L. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 12, 2489-2494(Dec 1973).

The virial theorem is applied to the elastic scattering of s wave electrons by helium using a variational ground state helium wave function which provides a satisfactory analytic fit to the Hartree–Fock function. It is found that when the scaling parameter α is introduced into the wave function of the bound state electrons in

the target atom, as well as the free electron function, this additional scaling has very little effect on the variational phase shift η_v in the exchange approximation but a profound effect when exchange is neglected. In the latter case it is not possible to optimize with respect to α and so $\Delta = \partial\eta_v/\partial k - (\partial\eta/\partial k)_{virial}$ never vanishes. However, if the criterion that $|\Delta|$ be a local minimum is adopted, it is found that the resulting values of the phase shift closely approximate those obtained in the exchange approximation and differ considerably from those calculated using the static potential with the atomic wave function unscaled. A similar occurrence arises in the case of the elastic scattering of electrons by atomic hydrogen. In the case of positron scattering by hydrogen and helium, where exchange is not possible, the additional scaling of the atomic wave function produces neither an optimum value of the phase shift nor a local minimum in $|\Delta|$. (auth)

19397 ELECTRON LOSS. Bates, D. R.; McDonough, W. R. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 12, 2572-2579(Dec 1973).

It is shown that despite their dissimilar appearance there is a close relation between the formula of Bates et al (J. Phys. B., Atom. Molec. Phys.; 2: 930-40 (1969)) for elastic electron loss in classical collisions and a formula derived from an intermediate stage of a development due to Thomas (Proc. Camb. Phil. Soc.; 23: 713-6 (1972)). The former represents an average over differential elastic scattering cross sections and the latter an average over the corresponding rate coefficients. Part-quantal treatments are introduced. As examples H–Ne and H–Ar collisions are investigated. The adoption of Born differential cross sections leads to elastic electron loss cross sections which are much too large. Their replacement by the exchange-polarization differential cross sections of Thompson (Proc. R. Soc.; A294: 160-74 (1966)) does not cause sufficient reduction. Combination of the exchange-polarization approximation with the peaking-impulse approximation is also unsatisfactory. Of the formulas considered the original classical one involves much the least computational effort and appears to give the best results. (auth)

19398 ENERGY TRANSFER IN N_2–ALKALI COLLISIONS. Andreev, E. A. (Inst. of Chemical Physics, Moscow). Chem. Phys. Lett.; 23: No. 4, 516-517(15 Dec 1973).

The quenching of alkali metals (A) and vibrational relaxation of N_2 by N_2–A collisions are considered and probabilities of different elementary processes are calculated. (auth)

Atomic Theory

Refer also to abstract 19802.

19399 NEW METHOD FOR THE CALCULATION OF LEVEL SHIFTS OF AUTOIONIZING STATES OF ATOMS WITH APPLICATION TO THE $2s2p\ ^{1,3}P$ AUTOIONIZING STATES OF TWO-ELECTRON ATOMS. Sharma, C. S. (London Univ.); Bowtell, G. Can. J. Phys.; 51: No. 15, 1637-1645(1 Aug 1973).

A new method for the calculation of level shifts of autoionizing states of atoms is developed. It is suggested that this method is simpler and yet more accurate and mathematically more rigorous than other methods previously used for such calculations. The claim is substantiated by both mathematical arguments and by actual application of the method to the $2s2p\ ^{1,3}P$ autoionizing states of two-electron atoms. (auth)

19400 ATOMIC INTEGRAL CONTAINING THREE ODD POWERS OF INTERELECTRONIC SEPARATION COORDINATES. Moussa, A. H.; Radi, H. M. A. (Univ. of Kuwait, Saudi Arabia). Comput. Phys. Commun.; 6: No. 2, 89-95(Aug 1973).

The program ATOMINT written in FORTRAN IV for the IBM 360/30 evaluates an atomic integral containing three odd powers of interelectronic separation coordinates, which appear in bound state variational calculations of three electron atoms and in phase shift variational calculations of scattering of electrons (or positrons) by two-electron atoms. (JFP)

19401 QUANTUM AND SEMI-CLASSICAL THEORIES OF A TWO-LEVEL ATOM INTERACTING WITH A SINGLE-FIELD MODE. Swain, S. (Queen's Univ., Belfast). J. Phys., A (London); 6: No. 12, L169-L173(Dec 1973).

Formally exact solutions to the quantum and semi-classical models of a single atom interacting with a single-field mode in the dipole approximation are compared. It is shown that the quantum results tend to the semi-classical ones in the limit $\bar{n} \to \infty$, in disagreement with the results of Chang and Stehle (Phys. Rev. A; 4: 641-61(1971)). (auth)

19402 DIRAC DYNAMIC INFORMATION RETRIEVAL OF ATOMIC CODES. II. Implementation. Davies, A. R.; Smith, K.; Kwok, K. L. (Univ. of Nebraska, Lincoln). Comput. Phys. Commun.; 6: No. 4, 165-186(Oct 1973).

The computer program DIRAC written in FORTRAN is described for the dynamic retrieval of information from a data bank upon a users request and the display of this information on an on-line 12'' × 12'' graphical display unit. The system can be used by any collection of theoretical codes for calculating cross sections; experimental points can also be fed into the data bank. (JFP)

19403 RELATIVISTIC DIRAC–FOCK EXPECTATION VALUES FOR ATOMS WITH Z = 1 TO Z = 120. Desclaux, J. P. (Centre d'Etudes de Limeil, Villeneuve St. Georges France). At. Data Nucl. Data Tables; 12: No. 4, 311-406(Nov 1973).

Numerical relativistic Dirac–Fock calculations for the average energy of the LS ground-state configuration of neutral atoms with Z = 1 to Z = 120 are presented. For open-shell systems a simple method is used to average over all the jj subconfigurations arising from the single LS configuration. The procedure of minimizing the average energy of the LS configuration allows a detailed comparison with nonrelativistic results and gives values slightly different from most of those previously published and obtained by considering only the lowest energy subconfiguration in jj coupling. Tabulations of total atom energies, orbital binding energies, one-electron integrals, expectation values of r^n for n = 6, 4, 2, 1, −1, −2, −3, and the radius at which the orbital density has its maximum value are presented. A comparison with nonrelativistic Hartree–Fock results is given for elements with Z = 1 to Z = 100. (auth)

19404 EXACT EVALUATION OF SLATER INTEGRALS USING ALTRAN, A SYMBOL MANIPULATION LANGUAGE. Fischer, C. F.; Prentice, D. W. B. (Univ. of Waterloo, Ont.). Comput. Phys. Commun.; 6: No. 4, 157-164(Oct 1973).

ALTRAN, a symbol manipulation language, is used to evaluate Slater integrals. An algorithm is described and a program listed; some results are presented, and the efficiency of this approach compared with direct numerical evaluation. (auth)

19405 APPROXIMATION OF d- AND f-TYPE ORBITALS BY SPHERICAL GAUSSIAN FUNCTIONS. Driessler, F.; Ahlrichs, R. (Institut fuer Physikalische Chemie und Elektrochemie, Karlsruhe, Ger.). Chem. Phys. Lett.; 23: No. 4, 571-574(15 Dec 1973).

In order to approximate atomic orbitals of d-, f- ... character as linear combinations of the minimum number of spherical gaussian functions a method is proposed to determine the necessary parameters: the gaussian mimic is required to approach the correct angular behavior in the limit R → 0, where R measures the off-center displacement of the gaussian lobes. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

19406 BOUNDARY LAYER EQUATIONS OF MAGNETOHYDRODYNAMICS WITH MOMENT STRESSES. Petrosian, L. G. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk; 26: No. 1, 25-30(1973). (In Russian).

A study is made of the MHD equations for a plane boundary layer of viscous incompressible fluid with moment stresses, an asymmetrical stress tensor, and internal particle inertia. Various types of plane boundary layer equations are considered for the case of a fluid with a large or infinite electrical conductivity and for the case of a fluid with a very small electrical conductivity. (IAA)

19407 MAGNETOHYDRODYNAMIC THEORY OF STABILITY OF MACLAURIN SPHEROIDS. Oganesyan, R. S.; Abramyan, M. G. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 6, 457-463(1972). (In Russian).

The question of stability of Maclaurin spheroids in the presence of toroidal magnetic field is considered. The stability concerning small surface perturbations of the type m = n = 2, which are decisive in the theory of liquid figure-(1, 2) is studied. It is established that the magnetic field ($B_0 \leq \omega\alpha\sqrt{2\pi\rho}$ [3]) does not alter the criterion of stability of oblate spheroids, but only changes the frequency of oscillations. (auth)

19408 CONTRIBUTIONS TO THE THEORY OF THE PROPAGATION OF MAGNETOHYDRODYNAMIC WAVES IN AN ELECTRICALLY CONDUCTIVE COMPRESSIBLE FLUID. II. Ignat, M. (Univ., Iasi). An. Univ. Timisoara, Ser. Stiinte Fiz.-Chim.; 7: 239-243(1969). (In Rumanian).

It has been shown in the first part of the article that by using Clebsch's theorem, the study of the slow motion of a compressible, electrically conducting fluid involves only the solution of certain equations with partial derivatives. Boundary conditions are presented for the case of a fluid which moves in a container with rigid walls, using the process to examine the propagation of magnetohydrodynamic waves within the space between 2 planes. Such a layer may represent the atmosphere in a spheric star with a large radius, such as the sun. The action of a constant magnetic field H_0, is taken into consideration, studying the magnetohydrodynamic waves under the assumption that the electrical conductivity is infinite. The analyzed physical phenomenon is determined by a transient process in which the magnetic field and the velocity of the fluid are derived from the initial field $\vec{H}_0$ and the dynamic state of the process. (TTT)

19409 EFFECTIVE ELECTRICAL CONDUCTIVITY AND RELATED PROPERTIES OF A NONEQUILIBRIUM HIGH PRESSURE MHD PLASMA. Brederlow, G.; Witte, K. J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 1, 83-90(Jan 1974).

Measurements are described of the effective electrical conductivity, the effective Hall parameter, the electron temperature and the electron number density made in an argon-potassium plasma over a wide range of current densities from 1 to 12 amp/cm^2, pressures from 2.1 to 8.2 bar and magnetic inductions from 1.1 to 3.6 Tesla at a gas temperature of 1800°K and a seed fraction of 0.05%. The aim of these investigations is to find out how well the available theories describing the influence of the magnetic field on the plasma properties mentioned can reproduce the experimental data. The measurements showed that in the entire parameter range investigated the theory based on a quasilinear analysis of plane ionization waves and also a semiempirical model agree with the experiment within the measuring accuracy as far as the effective electrical conductivity, the electron temperature and electron number density are concerned. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Electromagnetic

Refer also to abstracts 19066 and 19616.

19410 (JINR-E2-7509) RESTRICTIONS ON THE ANOMALOUS DIMENSIONS FROM ANALYSIS OF DEEP INELASTIC e−p SCATTERING DATA. Bilen'kaya, S. I.; Khristova, E. Kh.; Stamenov, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U.S. Sales Only) $3.00.

The SLAC-MIT data on deep inelastic e−p scattering are analyzed. In the expression for the structure function νW_2 a scaling breaking term, due to possible anomalous dimensions, is added. It is shown that the data are fitted well by different parametrizations of $R \equiv \sigma_1/\sigma_T$. It is shown also that the presently available SLAC-MIT data do not exclude anomalous dimensions. The value of the anomalous dimensions depends strongly on the parametrization of R. (auth)

19411 LANDOLT-BOERNSTEIN. Numerical Data and Functional Relationships in Science and Technology. New Series. Group I. Nuclear and Particle Physics. Volume 8. Photoproduction of Elementary Particles. Genzel, H.; Joos, P.; Pfeil, W. Berlin; Springer-Verlag (1973). 348p. (In English and German). $103.50.

Data on Compton scattering, photoproduction of π and η mesons, and photoproduction of K mesons below 1.5 GeV are given. For these interactions the total (integrated) cross sections, the differential cross section in the c.m. system, the ratio of differential cross sections, the asymmetry of linearly polarized incident photons, the polarization of the recoil baryon, and the asymmetry of a polarized target are presented. Data on photoproduction above the resonance region are presented for Compton scattering and photoproduction of pseudoscalar mesons, vector mesons, baryon resonances, and $S = \pm 1$ particles. The data include the total cross section, integrated cross sections, differential cross sections, and measurements with polarized photons. (LBS)

19412 MUON PAIR PRODUCTION BY ELECTRON−POSITRON ANNIHILATION AT 4 GeV CENTER-OF-MASS ENERGY. Feller, J. (Harvard Univ., Cambridge, MA); Litke, A.; Madaras, R.; Hanson, G.; Leong, J.; Newman, H.; Koch, J.; Tarnopolsky, G. Lett. Nuovo Cim.; 8: No. 18, 1020-1024(29 Dec 1973).

The measurement of the cross section for the $e^+e^- \rightarrow \mu^+\mu^-$ reaction using colliding beams of 2 GeV electrons and positrons at the Cambridge Electron Accelerator Bypass is described. The result $(2.2 \pm 0.9) \cdot 10^{-3}$ cm^2 was found to be in good agreement with QED. (LBS)

19413 PHOTOPRODUCTION OF ETA-MESONS ON HYDROGEN AT PHOTON ENERGIES BETWEEN 1.5 AND 2.2 GeV. Christ, A.; Husmann, D.; Jansen, W.; Loehr, B.; Reichelt, T.; Schilling, H. (Univ., Bonn). Lett. Nuovo Cim.; 8: No. 18, 1039-1043(29 Dec 1973).

The differential cross section of η photoproduction on hydrogen was measured for nine different photon energies between 1.5 and 2.2 GeV keeping the momentum transfer at about 0.27 (GeV)^2. The results show no significant bumps or shoulders above 1.6 GeV and seem to be consistent with a Regge-like behavior of η photoproduction above that energy. (LBS)

19414 DIFFERENTIAL CROSS SECTIONS FOR $\bar{p}p \rightarrow \pi^-\pi^+$, K^-K^+ BETWEEN 0.8 AND 2.4 GeV/c. Eisenhandler, E. (Queen Mary Coll., London); Gibson, W. R.; Hojvat, C. Phys. Lett.; 47B: No. 6, 531-535(24 Dec 1973).

Measurements are presented from a spark chamber experiment of the differential cross-sections for $\bar{p}p \rightarrow \pi^-\pi^+$, K^-K^+ at 20 momenta in the range 0.8 − 2.4 GeV/c (c.m. energy 2.02 to 2.57 GeV). The c.m. angular range was $-0.95 < \cos\theta^* < 0.95$. There are about 2000 $\pi^-\pi^+$ events and about 300 K^-K^+ events at each momentum. (auth)

19415 PION PRODUCTION IN $\bar{p}p$ AND $\bar{e}e$ ANNIHILATIONS. Everett, D.; Grossman, P.; Mason, P.; Muirhead, H. (Univ. of Liverpool). Phys. Lett.; 47B: No. 6, 541-542(24 Dec 1973).

Evidence is presented to show that the gross features of the pion distributions in $\bar{p}p$ and $\bar{e}e$ annihilation are essentially the same. (auth)

19416 INTERPRETATIONS OF THE DIFFERENTIAL CROSS SECTIONS FOR $\bar{p}p \rightarrow \pi^-\pi^+$. Eisenhandler, E. (Queen Mary Coll., London); Gibson, W. R.; Hojvat, C. Phys. Lett.; 47B: No. 6, 536-540(24 Dec 1973).

The differential cross sections for $\bar{p}p \rightarrow \pi^-\pi^+$ in the momentum range 0.8 to 2.4 GeV/c (center-of-mass energy 2.02 to 2.57 GeV) are analyzed in terms of the possible existence of s-channel resonances. The systematics of the dip structures and the s-dependence of $d\sigma/dt$ are presented. (auth)

19417 PHOTOPRODUCTION OF π^--MESONS ON DEUTERONS MONOCHROMATIC PHOTONS IN THE FIRST RESONANCE REGION. Boucrot, J.; Blum, D.; Grossetete, B.; McGill, W.; Nguyen Ngoc, H. (Universite Paris-Sud, Orsay, France). Nuovo Cim.; 18A: No. 4, 635-653(21 Dec 1973).

Photoproduction of π^--mesons on deuteron was studied in the first resonance region with an annihilation photon beam with adjustable peak energy (from 250 MeV to 400 MeV). A coincidence detection of both outgoing π^--meson and forward proton was performed with a set of 9 multiwire proportional chambers (1700 wires) inside the gap of a spectrometer. The momentum of the second proton is computed from three-body kinematics; their distribution is found in excellent agreement with the spectator model, even at the top of the resonance. The differential cross sections of π^- were measured from 100° to 180° (center of mass); they are in reasonable agreement with conventional multipole calculations and do not indicate an appreciable isotensor term. (auth)

19418 SCIENTIFIC PAPERS OF ARTHUR HOLLY COMPTON. X-ray and Other Studies. Shankland, R. S. (ed.). Chicago; University of Chicago Press (1973). 912p. $27.50.

The most important of Compton's papers on x radiation are collected and edited. They are reprinted in chronological order. (JFP)

Weak

19419 μ^+-MESON PRECESSION IN FERROMAGNETIC SUBSTANCES. Gurevich, I. I.; Klimov, A. I.; Maiorov, V. N.; Meleshko, E. A.; Muratova, I. A.; Nikol'skii, B. A.; Roganov, V. S.; Selivanov, V. I.; Suetin, V. A. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 1, 374-378(Jan 1974). (In Russian).

The polarization, precession frequency and μ^+-meson spin relaxation rate in transverse magnetic fields up to 1900 Oe are determined in magnetized iron, nickel and cobalt samples. The magnetic fields inducing μ^+-meson precession in ferromagnetic substances are considered. (auth)

19420 NEW MEASUREMENT OF THE MUON LIFETIME. Duclos, J.; Magnon, A.; Picard, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 47B: No. 6, 491-493(24 Dec 1973).

The mean life of the positive muon at rest was accurately measured in a zero magnetic field with a pulsed beam and found to be 2.1973 ± 0.0003 μs. (auth)

Strong (Baryon-induced)

19421 (DESY-73-51) OBSERVATION OF VECTOR MESON PRODUCTION IN INCLUSIVE PP REACTIONS. Blobel, V.; Fesefeldt, H.; Franz, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Cross sections, rapidity and transverse momentum distributions, and vector meson polarization were measured for the reactions $pp \rightarrow p^0$ + anything, $pp \rightarrow \omega$ + charged particles, and $pp \rightarrow K^{*\pm}$ + anything at incident laboratory momenta of 12 and 24 GeV/c. Various consequences of the results as well as possible connections with lepton pair production are discussed. (auth)

19422 (NP-19935-P1) NUCLEON−NUCLEON INTERACTION. Part 1. Brown, G. E.; Jackson, A. D. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). 1973. 154p.

A compendium is given of the very extensive technology associated with the problem of the nucleon−nucleon interaction. The deuteron and low energy neutron−proton scattering, electromagnetic properties of the deuteron in interactions with radiation, and proton−proton scattering are covered. (JFP)

19423 OBSERVATION OF VECTOR MESON PRODUCTION IN INCLUSIVE pp REACTIONS. Blobel, V. (Univ., Hamburg); Fesefeldt, H.; Franz, H.; Hellwig, B.; Idschok, U.; Lamsa, J. W.;

Moenkemeyer, D.; Neumann, H. F.; Roedel, D.; Schrankel, W.; Schwarz, B.; Selonke, F.; Soeding, P. Phys. Lett.; 48B: No. 1, 73-76(7 Jan 1974).

Cross sections, rapidity and transverse momentum distributions, and vector meson polarization were measured for the reactions $pp \rightarrow \rho^0 +$ anything, $pp \rightarrow \omega +$ charged particles, and $pp \rightarrow K^{*\pm} +$ anything at incident laboratory momenta of 12 and 24 GeV/c. Various consequences of the results as well as possible connections with lepton pair production are discussed. (auth)

19424 POLARIZATION OF SECONDARY PROTONS FROM THE $\gamma + p \rightarrow \pi^0 + p$ REACTION IN THE III RESONANCE REGION. Derebchinskii, A. I.; Tonapetyan, S. G.; Konovalov, O. G.; Nazyrov, V. R.; Tenishev, A. E. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 1, 68-73(Jan 1974). (In Russian).

Results are presented of measurements of the polarization of protons from the $\gamma + p \rightarrow \pi^0 + p$ reaction for photon energies between 980 and 1225 MeV and angles of 90° in the c.m.s. A peak at $E_\gamma \sim 1090$ MeV is observed in the energy dependence of the polarization. The polarization values obtained are compared with those calculated by Walker. A discrepancy is observed between the experimental and calculated polarization values. (auth)

19425 PROTON-PROTON AND PROTON-DEUTERON ELASTIC SCATTERING EXPERIMENTS AT NAL. Cool, R. L. (Rockefeller Univ., New York). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 453-460(31 Dec 1973).

Differential cross sections for p-p and p-d elastic scattering were measured at N.A.L. for $80 < s < 600$ GeV^2 in the four-momentum transfer range $0.001 < |t| < 0.15$ (GeV/c)^2. Preliminary values are given for the slope parameters in the diffraction region and for the ratio of the real to the imaginary scattering amplitude. The energy dependence of these parameters is discussed. (auth)

19426 REVIEW OF INELASTIC PROTON-PROTON REACTIONS. Morrison, D. R. O. (European Organization for Nuclear Research, Geneva). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 461-483(31 Dec 1973).

The most important new results on inelastic proton-proton scattering obtained with the new machines, I.S.R. and N.A.L., are: (1) The inelastic cross-section increases monotonically with energy from threshold to 1500 GeV/c. Above 6 GeV/c the energy variation has a $s^{+0.04}$ behavior. (2) Scaling is observed at I.S.R. energies in pion production. Confirmation is obtained of the hypothesis of limiting fragmentation. (3) The results are in general, consistent with the two-component model—one class of events being produced by diffraction dissociation and the other by a short-range-order process (e.g. the multiperipheral model). (4) There are indications that the protons have a granular structure; this from observation of secondaries of large transverse momenta. (auth)

19427 EXPERIMENTS ON PROTON-PROTON INTERACTIONS AT THE INSTITUTE OF HIGH-ENERGY PHYSICS, SERPUKHOV, USSR. Wetherall, A. M. (European Organization for Nuclear Research, Geneva). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 421-430(31 Dec 1973).

A summary of the work carried out at the Institute for High-Energy Physics, Serpukhov, U.S.S.R., on proton-proton interactions at energies between 10 and 70 GeV is given. The experiments comprise studies of small angle elastic scattering, of total cross sections and of interactions in a hydrogen bubble chamber. (auth)

19428 PROTON-PROTON SCATTERING AT CERN INTERSECTING STORAGE RINGS. Amaldi, U. (Instituto Superiore di Sanita, Rome). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 431-452(31 Dec 1973).

The main features of the C.E.R.N. Intersecting Storage Rings (I.S.R.) are reviewed, together with results obtained in 1971 and 1972 on elastic scattering and total cross sections. The main result is a 10% increase of the total proton-proton cross section in the I.S.R. energy range. The simplest picture of high energy proton-proton scattering which emerges from this and the other data, is briefly discussed. (auth)

19429 COHERENT PRODUCTION OF PARTICLES BY 200 GeV/c PROTONS IN NUCLEAR EMULSION. Jain, P. L.; Kazuno, M.; Ahmad, Z.; Girard, B.; Thomas, G.; Moses, H. (State Univ. of New York, Buffalo). Lett. Nuovo Cim.; 9: No. 4, 113-119(26 Jan 1974).

An analysis is made of 3-prong and 5-prong coherent events from an exposure of a stack of Ilford G_5 nuclear emulsion to a beam of 200-GeV/c protons. The coherent process is attributed to Coulomb dissociation and diffraction dissociation. Cross sections, multiplicity distributions, and interaction lengths are obtained. (LBS)

Strong (Meson-induced)

Refer also to abstract 19524.

19430 (JINR-P1-7523) MULTIPLICITY AND CORRELATIONS OF SECONDARY PARTICLES PRODUCED IN π^--^{12}C COLLISIONS AT 40 GeV/c. Grishin, V. G.; Inogamova, T. Ya.; Inogamov, Sh. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The analysis of the multiplicity distributions in π^--^{12}C interactions shows that the distributions are described qualitatively by Poisson and Polya formulas. The multiplicity data for π^--^{12}C interactions satisfy the same universal curve as π^-p and pp interactions (multiplicity scaling). The average multiplicity increase satisfies the logarithmic function of energy for π^--^{12}C and π^-p interactions with the same slope parameters. The correlation between neutral and charged pions in π^--^{12}C-interactions takes the form $\langle n_{\pi^0} \rangle = (1.64 \pm 0.11) + (0.16 \pm 0.02)\, n_s$, and the coefficients coincide with the similar results for π^-p and π^-n interactions at 40 GeV/c. Hence, one can conclude that intranuclear interactions are unimportant for this phenomenon. (auth)

19431 SINGLE PION PRODUCTION IN K$^+$d INTERACTIONS AS 4.6 GeV/c INCOMING MOMENTUM. Tavernier, S. P. K. Brussels; Univ., Brussels (1973). 139p.

Thesis.

Data are presented on single pion production in K$^+$d interactions at 4.6 GeV/c, obtained from a 7 events/μb exposure of the CERN 2-metre bubble chamber filled with deuterium. The following reactions are considered: $K^+n \rightarrow K^+\pi^-p$, $K^+n \rightarrow K^0\pi^0p$, $K^+n \rightarrow K^0\pi^+n$ and $K^+d \rightarrow K^0\pi^+d$. The differential and total cross sections of these processes were measured. Strong K(892) and K(1420) resonance production was observed. The decay distributions of those resonances were studied in the framework of the density matrix formalism. The need for an interference term between resonance and background was established. In the first reaction backward K(892) production was observed, some evidence in favor of the existence of a K around 1800 MeV was found and no evidence was found for the production of a K(1250) resonance. The possibility of an s-wave resonance in the K(1420) region is discussed. The last two reactions were compared to Veneziano model predictions, and a satisfactory agreement between theory and experiment was obtained for most distributions. The model calculations for the coherent interaction are particularly interesting since the result is sensitive to the relative phase of the amplitude for the reaction on a neutron and a proton. This prediction of the model was tested for the first time in this work. (auth)

19432 MEASUREMENT OF THE MULTIPLICITY OF SECONDARY PARTICLES IN π^--p, π^--n, AND π^--C INTERACTIONS AT 40 GeV/c. Abdullaeva, K. N.; Azimova, M.; Azimov, S. A.; Batraev, S. P.; Igamberdyev, K. R.; Lutfullaev, S. A.; Rizaev, Kh. A.; Trunova, E. I.; Usmanov, T. M.; Yuldashev, A. A.; Yuldashev, B. S. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 5, 25-27(1973). (In Russian).

The multiplicity of secondary particles from π^--p, π^--n, and π^--C interactions in a propane chamber exposed to a pion beam with a momentum of $r = 40 \pm 0.6$ GeV/c was measured. The multiplicities measured are tabulated. The dependence of the average number of γ quanta on the multiplicity of charged particles was also determined. (JSR)

19433 PRODUCTION OF THE $2\pi^+\pi^-$ SYSTEM ON LIGHT NUCLEI BY 4 GeV/c MESONS. Vasil'kova, A. D.; Gornov, M. G.; Matalygina, Zh. I.; Levina, V. I.; Protasov, V. P.; Sergeev, F. M. (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 231-233(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 393-397(5 Oct 1973).

It is shown that no process with participation of the virtual isobar $\Delta^-(1238)$ exists. The mechanism of the reaction is determined mainly by the production of a virtual π^- meson which is subsequently absorbed in the nucleus. (auth)

Particle Interactions and Properties (Theoretical)

19434 PROBLEMS OF THEORETICAL PHYSICS. Ginzburg, V. L.; Zel'dovich, Ya. B.; Leontovich, M. A.; Markov, M. A.; Ritus, V. I.; Sakharov, A. D.; Feinberg, E. L. (eds.). Moscow; Izdatel'stvo Nauka (1972). 495p. (In several languages).

Thirty-three papers are presented on theoretical problems in quantum field theory, elementary particle theory, classical and quantum electrodynamics, and many body quantum theory and solid state theory. Separate abstracts were prepared for twenty-four papers. One paper was previously abstracted for NSA and appeared as 27: 03776. The remaining papers were not within the subject scope of NSA. (LBS)

For abstracts of individual papers see: 19442–19444, 19463–19467, 19558–19560, 19891, 19921–19923, 19944–19951, and 19979.

General

Refer also to abstract 19675.

19435 (JEN-274) REGGEOLOGY: AN ELEMENTARY INTRODUCTION. Carreras, B.; Fernandez, E. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 119p. (In Spanish). Dep. NTIS (U. S. Sales Only) $8.00.

An elementary introduction to the ideas underlying the Regge-type models is given. The connection between the exchange models and the Regge form of the amplitude is shown. The analytic continuation of the amplitude from the t-channel to the s-channel is considered, leading to the Regge-type expression, and then some phenomenological applications are discussed. A generalization of the analytic continuation of the amplitude from the t-channel to the s-channel and its phenomenological applications to the scattering of nonzero spin particles is presented. Finally, Regge cuts are introduced, and new phenomenological applications are discussed. (auth)

19436 (JINR-E2-7420) PROBLEMS OF CONTEMPORARY ELEMENTARY PARTICLE PHYSICS AND PROSPECTIVE ACCELERATORS. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Some problems of elementary particle physics are considered which are connected with the construction of prospective accelerators. (auth)

19437 PARTICLE-INTERACTION PHYSICS AT HIGH ENERGIES. Lindenbaum, S. J. New York; Oxford University Press (1973). 523p. $48.00.

An account of pion physics and the physics of strange particles is given; then the classifications and theories of elementary particles are developed. Form factors and weak interactions follow, and the high energy behavior of total cross sections and elastic scattering conclude the book. The important aspects of the field are treated in historical perspective to give an overall view as well as a knowledge of its present state. (LBS)

19438 FUNDAMENTALS OF ELEMENTARY PARTICLE PHYSICS. Longo, M. J. McGraw-Hill Series in Fundamentals of Physics. New York; McGraw-Hill Book Company (1973). 235p. $9.95.

The spectrum of elementary particles is introduced in the first chapter, and their interactions are briefly discussed. Succeeding sections deal with the interactions in greater detail. More advanced concepts such as scattering and symmetry operations are presented through an intuitive approach. Feynman-type diagrams are also introduced. A large number of problems are provided for each chapter. (LBS)

19439 CLASSICAL RELATIVISTIC SCATTERING OF TWO DYONS. Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy); Beker, H. Nuovo Cim.; 19A: No. 2, 309-323(21 Jan 1974).

A remarkable phenomenon is reported in the relativistic classical scattering of two particles having both electric and magnetic charges, which is not present in the ordinary scattering of two singly charged particles, i.e., the occurrence of infinitely many singularities in the differential cross section. These singularities correspond to compound states formed by the scattered particle making n loops, n = 0, 1, 2, 3, . . . , around the scattering center; their positions are given by eq. (3.21) for the particular case studied. (auth)

19440 MULTICLUSTER MODEL. Multiple Generation of Hadrons. I. Potupa, A. S. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 116-118(1973). (In Russian).

Recent experiments on the high energy multiple production of hadrons ($n \to 2$) make it possible to reestablish the form of the amplitude T_{2n} (at least $|T_{2n}|^2$) in two limiting cases: 1) $n \to 2$ (binary reaction) and 2) $n \to n_{max}$ (threshold generation) where Regge exchange and single-cluster processes of that statistical type predominate respectively. A multicluster model was formulated as an interpolation between the threshold and asymptotic n-particle channels. This model generalizes the known multiperipheral and statistical schemes. (tr-auth)

19441 FUNDAMENTAL INTERACTIONS AND THE NUCLEUS. Blin-Stoyle, R. J. New York; American Elsevier, Inc. (1973). 357p.

The first chapter gives a review of the fundamental interactions, CP violation, and nuclear studies of the fundamental interactions. The remaining chapters treat nuclear β decay, the polar vector current in β decay, the axial-vector current in β decay, unusual hadron currents and interactions in β decay, the lepton current and the neutrino, μ-meson capture, the weak internucleon potential, the effect of a parity violating potential in low energy nuclear physics processes, time reversal noninvariance in nuclear reactions and electromagnetic transitions, electromagnetic and charge dependent interactions, and strong interactions in the nucleus. Five appendices are included that deal with: some notations and conventions; nonrelativistic quantum mechanics; relativistic quantum mechanics; quantized fields; isospin, charge symmetry, and G-parity, and current matrix elements. (LBS)

19442 TOPOLOGICAL STRUCTURE OF ELEMENTARY CHARGES AND CPT-SYMMETRY. Sakharov, A. D. (Lebedev Inst. of Physics, Moscow). pp 242-247 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

It is assumed that stable and quasi-stable elementary particles consist of a number of "elementary charges" with a complicated topological structure. The topological handles formed by identification of border points of two cavities called in the article "bases" of a handle are considered. In accordance with the hypothesis about the cosmological CPT-symmetry these bases are assumed to be a mirror reflections of each other according to $t \to -t$-reflection. Charges and anticharges are associated with bases with a topological structure of a cavity "tied" in a right or left knot. (auth)

19443 PARTICLE WITH NONEQUILIBRIUM PROPER FIELD. Feinberg, E. L. (Lebedev Inst. of Physics, Moscow). pp 248-264 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

A possibility to observe an elementary particle with nonequilibrium proper field, i.e., a particle with a field absent in peripheral regions, is discussed. Earlier (in 1965) it was shown that in quantum mechanics an electron can appear in such a state at high energy E after the large angle scattering. In that case the field is absent at the distance of r from the electron during the time $\tau \sim r/E/m_e c^3$ (m_e is an electron mass), which can be "macroscopically" large even at the Compton wave length distance if E/m_e^3 is large enough. In a time $\sim \tau$ the system decays into a normal electron with a field and a photon. The electron in such a "semidressed" state is observable and its bremsstrahlung and other interactions are anomalous. This effect is a classical one and it is shown how such a picture arises in classical electrodynamics. It is shown that the effect is efficient only for peripheral regions of a particle $r \geq \hbar m_e^c$ and does not influence the parts of field which are important for the electromagnetic mass of a particle. A possibility of the same effect for hadrons is discussed. In that case the exact calculations are impossible. It is shown that qualitative considerations make this possibility quite a plausible one. An example is given in which it is true, namely the diffraction dissociation of a deuteron in Glauber formalism. In that theory the deuteron diffractively interacting with a nucleus comes out with a cut-off, truncated peripheral structure and is a superposition of a stable deuteron and a deuteron decayed into a neutron and a proton. A "semidressed" nucleon with a lower (than normal) interaction cross section can be observed in practice only by the subsequent collisions inside of the nucleus because of the high nucleon mass. (auth)

19444 SPIN AND PSEUDOSPIN ORDERING. Vonsovskii, S. V.; Svirskii, M. S. (Inst. of Metal Physics, Sverdlovsk, USSR). pp 389-395 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

General questions of indefiniteness of multiplicity and pseudomultiplicity of physical systems with a spin or pseudospin ordering developed in a number of papers by the present authors are discussed. The role of multiplicity indefiniteness for the stabilization of collinear and non-collinear magnetic structures is determined. Methods of quantum theory of magnetic ordering apply to the systems of interacting fermions described by the corresponding pseudospin formalism. This offers a new approach to the classification of crystallic solid bodies according to the character of their superconductivity, and allows to generalize the microtheory of superconductivity. Pseudospin formalism is also applied to Dirac relativistic theory of the electron. (auth)

19445 EQUAL-TIME ALGEBRA AND LIGHT-CONE COMMUTATORS. Taha, M. O. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 18A: No. 4, 663-674(21 Dec 1973).

The sum rules of equal-time algebra are discussed in a refined form of the infinite-momentum limit and it is shown that they reduce to those obtained from light-cone commutators. (auth)

19446 PARTICLE MOMENTUM CUT-OFF IN INCLUSIVE PROCESSES IN THE REGION OF LARGE ANGLES. Ezhela, V. V.; Logunov, A. A.; Mestvirishvily, M. A.; Petrov, V. A.; Rcheulishvily, G. L. (Inst. for High Energy Physics, Serpukhov, USSR). Phys. Lett.; 47B: No. 6, 501-504(24 Dec 1973).

It is shown that analyticity and unitarity lead to logarithmic cut-off of particle momentum detected in binary inclusive process in the region of large angles. (auth)

19447 UNIVERSAL LENGTH AND ITS ROLE IN THE RISING PROTON-PROTON TOTAL CROSS SECTION. A New Domain of Physics With the Length Scale of 10^{-16} cm. Kim, D. Y. (Univ. of Saskatchewan, Regina). Lett. Nuovo Cim.; 9: No. 3, 71-74(19 Jan 1974).

A study is made on a recent model for a possible mechanism for rising total cross section, as due to the hadronic structure (parton model), on a nonlocal field theory approach of CP-violating kaon decay, and on calculation of velocity dependence of the decay lifetime for a test of a possible violation of Lorentz invariance. The results suggest the presence of a new domain of physics with the scale length of 10^{-16} cm., namely the universal length. (LBS)

19448 QUARK STRUCTURE AND OCTONIONS. Guenaydin, M.; Guersey, F. (Yale Univ., New Haven). J. Math. Phys. (N. Y.); 14: No. 11, 1651-1667(Nov 1973).

The octonion (Cayley) algebra is studied in a split basis by means of a formalism that brings out its quark structure. The groups SO(8), SO(7), and G_2 are represented by octonions as well as by 8×8 matrices and the principle of triality is studied in this formalism. Reduction is made through the physically important subgroups SU(3) and SU(2) ⊗ SU(2) of G_2, the automorphism group of octonions. (auth)

19449 NONLINEAR LEE MODEL. II. Calogero, F. (Univ., Rome). J. Math. Phys. (N. Y.); 14: No. 11, 1692-1705(Nov 1973).

The nonlinear Lee model is characterized by the Hamiltonian $H = H_0 + f(H_1)$, where f(x) is a largely arbitrary (real) function and H_0 resp. H_1 are the free resp. interaction parts of the usual Lee model. The exact solutions of this field-theoretical model, in some sectors of its Hilbert space, are explicitly displayed; they are similar to, but somewhat richer than, the corresponding solutions of the usual Lee model. The V-Nθ and VN-NNθ sectors are treated in detail. (auth)

19450 CLASSICAL MOTIONS OF SPIN ½ PARTICLES WITH ZERO ANOMALOUS MAGNETIC MOMENT. Pardy, M. (Univ., Brno). Acta Phys. Slovaca; 23: No. 1, 5-12(1973).

An equivalent system of equations corresponding to the Dirac equation is derived and the WKB approximation of this system is found. Similarly, the WKB approximation for the equivalent system of equations corresponding to the squared Dirac equation is found, and it is proved that the Lorentz equation and the equation for the spin motion result from this system. (auth)

Electromagnetic

19451 (DESY-73-33) HADRON PRODUCTION IN VIRTUAL PHOTON-PHOTON ANNIHILATION. Koepp, G.; Walsh, T. F.; Zerwas, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 47p. Dep. NTIS (U. S. Sales Only) $4.50.

A systematic study was made of the amplitudes for annihilation of two virtual photons into hadron resonances and continuum states, a process measurable with colliding electron-positron beams. The asymptotic behavior of resonance form factors and their absolute scale follows from light cone or parton model considerations; definite predictions for inclusive two-photon annihilation are derived by the same methods. (auth)

19452 (DESY-73-47) INFORMATION CONTENT OF BEAM POLARIZATION IN e^+e^- → MULTIHADRONS. Avram, N. M.; Schiller, D. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Oct 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

The density matrix elements of the final multihadron states produced in e^+e^- annihilation, and the additional information obtainable, in the one-photon exchange approximation, from beam polarization, are discussed. It turns out that most of the new information is due to the longitudinal polarization of at least one beam. Nothing can be learned from the transverse polarization of only one beam, and very little from that of both beams. (auth)

19453 (RL-73-135) INCLUSIVE ELECTROPRODUCTION IN THE PHOTON FRAGMENTATION REGION. Lam, W. S.; Tran Thanh Van, J.; Uschersohn, I. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Nov 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The Regge-Mueller description is applied to the inclusive electroproduction of positive and negative pions with proton and neutron targets. It is shown that in the photon fragmentation region there is an excess of positive pion production over the negative pion production with proton target, then there is also an excess of positive pion production over the negative pion production with neutron target. Predictions of the x-distributions of the inclusive cross sections with the neutron target calculated from the proton target data are in good agreement with the experimental results. Following the argument in duality, the data are analyzed using the triple Regge formula. It is found that the contribution of the pion pole is important even at large value of q^2. (auth)

19454 (RL-73-154) IDEAS ON PHYSICS WITH EPIC. Manning, G. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 41p. Dep. NTIS (U. S. Sales Only) $4.25.

A description is presented of EPIC (Electron Proton Intersecting Complex or Electron Positron Intersecting Complex) with diagrams of the proposed machine. The physics with an e^+e^- system is discussed under the headings: e^+e^- annihilation, γγ events, and weak interaction effects in e^+e^-. The physics with an ep system is considered under the headings: photoproduction, deep inelastic scattering, and weak interactions. The conclusions reached at an EPIC study week are discussed under the headings: design of a solenoid system, bunched or DC beams, transverse field spectrometers, and ep or e^+e^- first? (UK)

19455 PARTON DISTRIBUTION IN THE MULTIPERIPHERAL PARTON MODEL. Takahashi, K. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 9: No. 1, 23-28(5 Jan 1974).

An attempt is made to find the parton distribution function consistent with the multiperipheral parton model using the following fundamental assumptions: each parton gives the same contribution to the distribution function, and each multiperipheral diagram satisfies the complete factorization. The one-parton distribution function is obtained and applied to electron-hadron deep inelastic scattering. Good agreement with experiment was obtained for the proton but not for the neutron. (LBS)

19456 AMBIGUITY OF THE MUON ANOMALOUS MAGNETIC MOMENT IN GAUGE-INVARIANT THEORIES. Ivanov, A. N. (Leningrad Polytechnical Inst.). Yadern. Fiz.; 18: No. 6, 1283-1295(Dec 1973). (In Russian).

The ambiguity of the muon anomalous magnetic moment arising in the unitary gauge calculation is studied in the framework of gauge-invariant models of weak and electromagnetic interactions of leptons. It is shown that the ambiguity is connected with linearly divergent integrals which appear only in the unitary gauge. The ambiguity disappears if the self-energy diagrams are added to the vertex diagram. In this case the linearly divergent integrals compensate similar integrals arising in self-energy diagrams. Then the integration variables are fixed by Ward's identity $q_\alpha \Gamma_\alpha = G^{-1}(k) - G^{-1}(k')$. The remaining expression determines the correct value of the muon anomalous magnetic moment. (auth)

19457 HADRON PRODUCTION BY WEAK INTERACTIONS IN e^+e^- COLLISIONS. Koegerler, R.; Pietschmann, H. (Univ., Vienna). Lett. Nuovo Cim.; 8: No. 18, 1013-1019(29 Dec 1973).

An attempt is made to show that weak contributions to hadron production in e^+e^- experiments will exceed at some energy purely electromagnetic processes due to two reasons: firstly, a logarithmic dependence on the energy, and secondly, a drastic rise with some power of energy which is typical for weak-interaction cross sections. This phenomenon is investigated by studying the reactions $e^+ + e^- \to e^- + \bar{\nu}_e + \pi^0 + \pi^+$ and $e^+ + e^- \to e^- + \bar{\nu}_e + \rho^+$. (LBS)

19458 NEED FOR OFF-DIAGONAL TERMS IN THE HYPOTHESIS OF GENERALIZED VECTOR-MESON DOMINANCE. Cocho, G.; Gregorio, M.; Leon, J.; Rotelli, P. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Lett.; 48B: No. 1, 63-66(7 Jan 1974).

It is argued that the diagonal ansatz in GVMD models is theoretically unjustified, and it is shown that off-diagonal contributions are necessary to explain recent data on the electroproduction of polarized vector mesons. (auth)

19459 QUARKS AND THE HELICITY STRUCTURE OF PHOTOPRODUCTION AMPLITUDES. Hey, A. J. G.; Weyers, J. (CERN, Geneva). Phys. Lett.; 48B: No. 1, 69-72(7 Jan 1974).

Algebraic properties of the transformation between constituent and current quarks are used to derive the helicity structure of photoproduction matrix elements. (auth)

19460 HIGGS MESONS AND HIGH ENERGY BEHAVIOR. Schechter, J. (Syracuse Univ., NY); Ueda, Y. Lett. Nuovo Cim.; 8: No. 17, 991-993(22 Dec 1973).

It is pointed out that the auxiliary "Higgs" scalar meson plays a crucial role in securing good high-energy behavior for the simple reaction $e^-(q) + e^+(q') \rightarrow w^-(p) + w^+(p')$, where w^- and w^+ are external mesons. (LBS)

19461 UNITARITY RELATION FOR DEEP INELASTIC SCATTERING. Dahmen, H. D.; Steiner, F. (CERN, Geneva). Phys. Lett.; 48B: No. 1, 55-59(7 Jan 1974).

Saturating the multiparticle states in the unitarity relation for virtual Compton scattering by two-particle states consisting of an infinite set of high mass vector mesons and a nucleon leads to a non-linear integral equation the solution of which determines the behavior in the scaling limit and the non-forward scaling functions for deep inelastic scattering. (auth)

19462 DIFFRACTION DISSOCIATION IN ELECTROPRODUCTION. Rittenberg, V. (Rockefeller Univ., New York); Dorren, J. D. Phys. Lett.; 48B: No. 1, 51-54(7 Jan 1974).

Based on the current phenomenological observation that pomeron-proton scattering is similar to hadron-hadron scattering, it is conjectured that pomeron-photon scattering has similar properties to photon-nucleon scattering. Using this analogy some clear predictions are made about the diffraction dissociation of the photon in electroproduction. (auth)

19463 DEEP INELASTIC ELECTROMAGNETIC AND WEAK INTERACTIONS OF HADRONS AND PROPERTIES OF CURRENT COMMUTATORS. Ioffe, B. L. (Inst. of Theoretical and Experimental Physics, Moscow). pp 208-218 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Matrix elements of current commutators on the light cone are calculated in detail using the well-known experimental behavior four of deep inelastic electro- and neutrinoproduction cross sections. The knowledge of equal-time current commutators allows in particular to check different hypothesis about the form of the bare currents in a Lagrangian and to clear up the validity of some sum rules derived with the help of equal-time commutation relations and some additional assumptions. (auth)

19464 ELECTROMAGNETIC AND GRAVITATIONAL INTERACTIONS OF MAJORANA PARTICLES. Kobzarev, I. Yu.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). pp 219-223 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

It is shown that the equivalence of a zero-mass Majorana neutrino and of a two-component Weyl neutrino is not destroyed by electromagnetic interactions. The problem of possible variants of neutrino's gravitational interaction is considered in connection with the problem of the existence of "steryle" neutrino. (auth)

19465 CLASSICAL LIMITS IN BREMSSTRAHLUNG. Low, F. E. (Massachusetts Inst. of Tech., Cambridge). pp 290-298 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972).

A simple derivation of the low frequency bremsstrahlung produced by a scattering process is given. The total energy radiated by a charged particle in a screened Coulomb field is studied in detail for the case of classical parameters. A violent difference between attraction and repulsion is found. In the former case no classical calculation is valid. In the latter, the quantum region with small impact parameter does not enter significantly and the classical calculation is self-consistent. (auth)

19466 RADIATION OF CHARGED PARTICLES IN INHOMOGENEOUS MEDIUM. Ter-Mikaelyan, M. L. (Inst. of Physical Research, Erevan). pp 335-349 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

A brief review of the radiation theory of charge particles in a random medium, and also in a medium with periodic properties, is given. The main attention is concentrated on the physical picture of the phenomena. The close interconnection of the described effects with the Vavilov-Cherenkov radiation is emphasized. (auth)

19467 COHERENT RADIATION OF A FAST ELECTRON IN A MEDIUM. Frank, I. M. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 350-378 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The article is devoted to the history of the discovery of Vavilov-Cherenkov radiation and of the joint work of the author with I. E. Tamm which led to the formulation of the theory of this effect. Physical reasons for the origin of Vavilov-Cherenkov radiation, the region of its formation (the coherence length) and its role in other effects caused by the influence of the medium upon the radiation of fast particles are considered in detail. (auth)

19468 EFFECT OF SINGULAR OPERATOR PRODUCTS ON A HARD-PION CALCULATION. Golowich, E. (Univ. of Massachusetts, Amherst). Nuovo Cim.; 18A: No. 4, 747-759(21 Dec 1973).

A previous derivation of a hard-meson dynamical equation for the pion form factor is generalized to take into account the effect of singular operator products. The content of the relation in the limit of infinite momentum transfer is then investigated, yielding an expression for the asymptotic behavior of an $A_1(1070)$ form factor with both external legs off shell. (auth)

19469 LOW ENERGY THEOREMS FOR PHOTONS AND THE INFRARED DIVERGENCES. Gerdzhikov, V. S.; Kulish, P. P. (Leningrad State Univ.). Teor. Mat. Fiz.; 18: No. 1, 51-55(Jan 1974). (In Russian).

Scattering amplitude of a charged particle with an additional soft quantum emission is shown to be regular in the neighborhood of the zero value of the quantum momentum if the infrared divergenceless approach is used. (auth)

19470 MOTION OF IONS IN A UNIFORM MAGNETIC FIELD. Felderhof, B. U. (Queen Mary Coll., London). Physica; 69: No. 2, 433-440(1 Nov 1973).

The motion of ions in a uniform magnetic field is studied. It is shown that the coupling between center-of-mass and internal variables gives rise to a slightly modified cyclotron motion. Hence a small shift of the total mass is deduced. (auth)

19471 BREMSSTRAHLUNG OF AN ELECTRON NEAR A NUCLEUS LOCATED IN A STATIONARY EXTERNAL FIELD. Zhukovskii, V. C. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 66: No. 1, 9-15(Jan 1974). (In Russian).

The bremsstrahlung cross section for electrons near a nucleus located in a stationary crossed field is calculated by the equivalent photon method. The result is extended to the case of an arbitrary field. It is shown that the stationary external field exerts its greatest action in the low frequency range in which synchrotron radiation is maximal. (auth)

19472 GRAVITATIONAL RADIATION OF ULTRARELATIVISTIC CHARGED PARTICLES IN AN EXTERNAL ELECTROMAGNETIC FIELD. Sushkov, O. P.; Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 1, 3-8(Jan 1974). (In Russian).

It is shown how the intensity of gravitational radiation of ultrarelativistic charge in an external electromagnetic field can be found. The method is applicable to a broad class of problems. A closed expression is obtained for the radiation intensity in the case of circular motion in a Coulomb field. (auth)

19473 MAGNETIZM MIKROCHASTITS. (Magnetism of Microparticles). Vonovskii, S. V. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko-Matematicheskoi Literatury (1973). 281p.

The contemporary state of the physical representations on the magnetic properties of elementary particles — electrons, positrons, muons, protons, neutrons, and other hadrons as well as the electron shell of atoms and atomic nuclei — was discussed. Knowledge of the magnetic properties of microparticles has not only independent interest but also gives useful information of their internal structure. Questions on the anomalous magnetic moments of both leptons and hadrons are examined in detail. The theory and the experimental search for the Dirac magnetic monopole are discussed. Some nonlinear quantum electrodynamic effects in magnetic fields are examined briefly. (tr-auth)

19474 RADIATION BY AN ELECTRON IN A COULOMB FIELD. Scott, J. M. C. (Cambridge Univ., Eng.). J. Phys., A (London); 6: No. 12, 1853-1861(Dec 1973).

The cross section for free-free transitions — bremsstrahlung at nonrelativistic velocities — can be reduced to simple formulas in various limiting cases. In two of these cases, the quantum-mechanical result is known to agree with Kramers' classical calculations (namely $g = 1$ and $g = (\sqrt{3}/\pi)\mathrm{Ln}(\ldots)$ in the usual "Gaunt factor" notation of astrophysicists). The intermediate case does not seem to have been completely cleared up, and it is investigated. The result found does not agree with the formula of Elwert (Ann. Phys.; Lpz 34: 178-207 (1939) and Z. Naturf.; 3A: 477-81 (1948)); it depends on a function of a single variable, and coincides with the classical result. This bridges the gap between the two low-frequency formulas. A short table of the function is given. A method is given for calculating the cross section in the more general conditions in which g is nearly equal to 1 ($h\nu$ not small compared with $\frac{1}{2} mv^2$). There is a region of overlap between the result so obtained and the preceding one, which provides a check on the correctness of both. (auth)

19475 QUANTUM STOCHASTIC PROCESSES AND THE FEYNMAN PATH INTEGRAL FOR A SINGLE SPINLESS PARTICLE. Garczynski, W. (Univ., Wroclaw). Rep. Math. Phys.; 4: No. 1, 21-46(Mar 1973).

A general scheme of a theory of the quantum stochastic processes is outlined in analogy to the theory of the classical stochastic processes. Special attention is paid to the simplest possible case of physical interest, namely, to the description of a single, spinless nonrelativistic particle moving in the presence of an external electromagnetic field. The idea of quantum stochastic processes is developed by introducing explicitly random variables describing the position of a particle at different times. The transition amplitude, which before played the leading role, may be expressed in terms of these variables and some complex-valued average operations. These operations substitute the measure theoretical notions used in the theory of classical stochastic processes. It was shown that the solutions of Cauchy's problem for the general Schrodinger equations may be expressed as, what is called, quantum averages of some functionals on the process. As one knows these solutions are usually written in the form of heuristic Feynman path integrals. Therefore, the formulas give a mathematical meaning to the Feynman path integrals. A factor-ordering ambiguity is analyzed and removed by a convention concerning the stochastic integrals involved. (auth)

19476 SOME RESULTS IN INCLUSIVE e^+e^- ANNIHILATION INTO HADRONS. Greco, M. (CNEN, Frascati, Italy); Srivastava, Y. Nuovo Cim.; 18A: No. 4, 601-614(21 Dec 1973).

e^+e^- annihilation into multihadrons is investigated through the energy-momentum conservation sum rules. Canonical scaling results for total cross section and $\overline{F}_1$, $\overline{F}_2$ are obtained and new scaling results for 2-particle inclusive processes are derived. The high-energy behavior of the multiplicities is discussed in terms of the correlation functions, in analogy with the purely hadronic case. A sum rule is obtained connecting single and double pion production. Finally, in a self-consistent way, using FESR and EVMD model, the pion form factor and structure function are estimated phenomenologically. A striking prediction is that, near $x \simeq 1$, the pion structure function $F_2^\pi(x)$ may be an order of magnitude or more larger than that of the proton. (auth)

19477 INCOHERENT $K_L^0 \rightarrow K_S^0$ REGENERATION ON ATOMIC ELECTRONS AT HIGH ENERGIES, AND THE ELECTRIC RADIUS OF THE K^0 MESON. Lyuboshitz, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 253-255(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 432-435(5 Oct 1973).

It is noted that the cross section for coherent regeneration of K_S^0 mesons when K_L^0 mesons interact with atomic electrons increases rapidly with increasing K_L^0-meson energy. As a result, at very high energies (~100 GeV), the reaction $K_L^0 + e \rightarrow K_S^0 + e$ can be used for an experimental determination of the K^0-meson rms radius, which characterizes the electric-charge distribution. The energy spectrum of the relativistic recoil electrons is considered and numerical estimates are given. (auth)

19478 GAUGE MODELS OF WEAK INTERACTION AND SUPERCHARGED HADRONS. Nikolaev, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 263-265(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 447-451(5 Oct 1973).

The possibility of searches for supercharged (charmed) hadron in a neutrino experiment and in pp interactions at high energies is discussed. (auth)

19479 UNIFIED THEORY OF ELECTROMAGNETISM AND WEAK INTERACTION. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta). Int. J. Theor. Phys.; 8: No. 5, 323-330(1973).

A unified theory of weak and electromagnetic interaction developed on the basis of the assumption that the charge and mass of a lepton are of dynamical origin. According to this model, the spontaneous breakdown of symmetry generates the photon as a Goldstone boson. (auth)

19480 ANALYSIS OF SPIN CORRELATIONS IN THE $\gamma\mu^- \rightarrow e^-\tilde{\nu}_1\tilde{\nu}_2$ PROCESS. Romanov, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 2000-2002(Sep 1973). (In Russian).

The process of the interaction of γ quanta with negative muons, leading to the formation of electrons and antineutrinos, $\gamma\mu^- \rightarrow e^-\tilde{\nu}_1\tilde{\nu}_2$, was examined. The analysis was made in the case of the (V−A) variant of the coupling of $(e^-\tilde{\nu}_1)$ and $(\mu^-\tilde{\nu}_2)$ currents. It was shown that, in agreement with the description examined, the produced antineutrinos should have opposite helicity, but $\tilde{\nu}_2$ and muons have the same. The electron should appear with helicity opposite to that of $\tilde{\nu}_1$. (tr-auth)

19481 GRIBOV'S REGGEON CALCULUS AND HIGH ENERGY COMPTON SCATTERING OF PROTONS. Saleem, M. (Punjab Univ., Lahore). Lett. Nuovo Cim.; 9: No. 4, 123-126(26 Jan 1974).

Gribov's Reggeon calculus is used to calculate the differential cross sections for Compton scattering of protons at high energy and for four-momentum transfer squared between $0 \leq -t \leq 0.7$ $(GeV/c)^2$. The results are found to be in favorable agreement with experimental values at 16 and 17 GeV. (LBS)

19482 ELECTROPRODUCTION OF HIGHER SPIN RESONANCES WITHIN A GENERALIZED JOOS-WEINBERG FORMALISM. Eeg, J. O. (Univ. of Oslo). Lett. Nuovo Cim.; 9: No. 4, 141-145(26 Jan 1974).

Electromagnetic currents for transitions from spin s to another spin s' (s' is an arbitrary integer for $s = 0$ and an arbitrary half-integer for $s = \frac{1}{2}$) are presented in terms of spinors satisfying Weinberg's equation and generalized $2(2s+1) \times 2(2s'+1)$ Joos-Weinberg matrices. When the currents are transformed to the Breit frame, they involve terms which are interpreted as form factors for different electromagnetic multipole transitions. Assuming current-current coupling with one-photon exchange, the unpolarized cross section for high energy electron scattering by spin-s target ($s = 0, \frac{1}{2}$) at electroproduction of a spin-s' resonance is obtained. (LBS)

19483 MUON DECAY AND EQUIVALENCE PRINCIPLE. Peres, A. (Technion-Israel Inst. of Tech., Haifa). Lett. Nuovo Cim.; 9: No. 4, 146(26 Jan 1974).

It is pointed out that the formula given by Smorodinskii (JETP Lett. 16:356(1972)) for the proper time for a charged particle in an electromagnetic field cannot be correct, because it is not gauge invariant. A consequence of the formula would be that a muon moving in a circular orbit in a cyclotron, thus enclosing a large amount of magnetic flux, would have a longer lifetime than a free muon moving with the same speed. (LBS)

19484 SEMI-LEPTONIC PROCESSES AND CHIRAL $SU_3 \times SU_3$ SYMMETRY. Aguirre, E.; Esteve, A.; Gutierrez, J.; Tiemblo, A. (Instituto Rocasolano, Madrid). Nuovo Cim.; 19A: No. 3, 325-351(1 Feb 1974).

There have been several papers devoted to the problem of introducing baryons in the $SU_3 \times SU_3$ symmetry. A systematic treatment of this matter especially in what concerns the phenomenological currents acting in semi-leptonic weak processes is presented. Couplings with spin-1 mesons were also studied, looking for pole model approaches of weak form factors. Goldberger-Treiman relations are obtained which exhibit for $\Delta S = 1$ a breaking dependence that is taken along the σ_0 and σ_8 directions. The SU_3 breaking characterized by introducing a parameter $\lambda = [\sqrt{2/3}\ \langle\sigma_0\rangle_0 - (1/(2\sqrt{3}))\ \langle\sigma_8\rangle_0]/[\sqrt{2/3}\ \langle\sigma_0\rangle_0 + (1\sqrt{3})\ \langle\sigma_8\rangle_0]$ seems to be near unity everywhere. Electromagnetic and weak interactions were omitted because the only breaking that can be explained in terms of exclusively spontaneous rupture is the so-called medium-strong breaking. (auth)

19485 DUAL MODEL FOR PHOTO- AND ELECTROPRODUCTION. Dorren, J. D.; Drummond, I. T. (Cambridge Univ., Eng.). Nuovo Cim.; 19A: No. 3, 445-469(1 Feb 1974).

A Regge model for pseudoscalar photo- and electroproduction is abstracted from some recent work on dual off-shell amplitudes. The theory suggests that a half-slope companion trajectory accompanies every standard trajectory in off-shell amplitudes. As a result a reasonable description of the energy dependence of photoproduction is obtained at large momentum transfer. Predictions are made about the dependence on the photon mass of the electroproduction cross sections both at fixed energy and fixed ω (the scaling variable). In the former case the slope of the differential cross section decreases with increasing photon mass and in the latter case it increases logarithmically. Some future difficulties for the model are pointed out which highlight the importance of measuring the deep inelastic electroproduction of sequences of resonances. (auth)

19486 MODEL FOR THE DEEP INELASTIC ANNIHILATION FUNCTIONS OF THE NUCLEON. Benfatto, G. (Univ., L'Aquila, Italy); Preparata, G.; Rossi, G. C. Nuovo Cim.; 19A: No. 3, 430-444(1 Feb 1974).

A model for the deep inelastic annihilation functions of the nucleon is made, based on ideas about their analyticity structure. Predictions for cross sections and multiplicities are presented. (auth)

19487 BREMSSTRAHLUNG IN A STRONG RADIATION FIELD. Elyutin, P. V. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2196-2202(Dec 1973). (In Russian).

The cross section for multi-quantum emission and absorption are calculated for scattering by a Coulomb potential in the presence of a strong electromagnetic field. Estimates of the ab-

sorption coefficient of a plasma in a strong field are obtained. (auth)

19488 BOOTSTRAPPED ELECTRON PAIR PRODUCTION IN EXTRA-GALACTIC SOURCES. Bonometto, S. A. (Univ., Padua); Lucchin, F. Nuovo Cim.; 18B: No. 2, 225-236(11 Dec 1973).

Possible observational peculiarities due to the occurrence of electron pair production in extra-galactic sources are studied; the case of steep spectra is outlined; a possible enhancement of the pair production reaction due to its very occurrence is also proven for a set of models built on the basis of the data observed for 3C 273 and NGC 1275. (auth)

19489 POMERON EXCHANGE DUAL ABSORPTIVE MODEL FOR ELASTIC PHOTOPRODUCTION OF ρ^0 MESONS ON CARBON AT HIGH ENERGY. Saleem, M.; Tirmazi, S. H.; Aslam, M. (Punjab Univ., Lahore). Lett. Nuovo Chim.; 9: No. 4, 120-122 (26 Jan 1974).

The differential cross section of elastic photoproduction of ρ^0 from ^{12}C at 8.8 GeV and for small momentum transfer is calculated using Harari's dual absorptive model and by considering the pomeron trajectory the dominant trajectory at high energy. (LBS)

19490 DIRAC MONOPOLES FOR GENERAL GAUGE THEORIES. Klimo, P.; Dowker, J. S. (Univ. of Manchester, Eng.). Int. J. Theor. Phys.; 8: No. 6, 409-417(1973).

A nonlocal potential formalism for general gauge theories. With the help of this mathematical apparatus an argument for quantization of the generalized charge is given, assuming that the Dirac monopoles are present. (auth)

Weak

19491 SPINORIAL EQUATIONS FOR NEUTRINO IN NON-EUCLIDIAN SPACES. Toro, T. An. Univ. Timisoara, Ser. Stiinte Fiz.-Chim.; 9: No. 2, 131-138(1972). (In French).

Different spinorial equations for neutrino in non-Euclidian spaces are analyzed. In this sense, to be able to approach the interaction of neutrino with the gravity field, an interaction which seems to play a bigger and bigger role in astrophysics and in modern relativistic cosmology, first of all the spinorial equation for neutrino in Riemann spaces with 4 dimensions is written using the local spin connection of Fock–Ivanenko. Then, other non-Euclidian spaces are also considered—as it is for example the Finsler type space—and the corresponding equations for the neutrino in this space are written. Finally, these equations are considered in the case of a nonlocal spin connection, and it is shown that in this case the spinorial equations for neutrino will be integral-differential equations. (auth) (Rom. Sci. Abstr.)

19492 GAUGE THEORIES. Abers, E. S.; Lee, B. W. (State Univ. of New York, Stony Brook). Phys. Rep.; 9: No. 1, 1-141 (Nov 1973).

Gauge models of weak and electromagnetic interactions and the quantization and renormalization of gauge theories are treated. (JFP)

19493 HIGHLY INELASTIC NEUTRINO REACTIONS PREDICTED FROM THE πN TOTAL CROSS SECTIONS. Suzuki, M. (Univ. of California, Berkeley). Nucl. Phys.; B66: 368-380(1973).

The scaling function $F_2(\omega)$ is calculated for the highly inelastic neutrino and antineutrino reactions from the πN total cross sections on the basis of the generalized scaling sum rules. With the optimum values for the parameters determined in a previous analysis the integral $\int_0^1 dx\,(F_2^{\nu p}(x) + F_2^{\bar{\nu} p}(x))$ saturates almost completely the inequality of the parton quark model. The ultraprecocious linear rise of the total cross sections for the neutrino and anti-neutrino reactions is a natural consequence of the generalized scaling sum rules. (auth)

19494 AVERAGE TRANSVERSE MOMENTUM OF THE QUARKS WITHIN A MESON. Leutwyler, H. (Institut fuer Theoretische Physik, Bern). Phys. Lett.; 48B: No. 1, 45-47(7 Jan 1974).

The leptonic decay rates of K-mesons are used to impose rather stringent constraints on the average transverse momentum of the quarks composing it. (auth)

19495 DECAY $\Sigma^+ \to Ae\nu$ AND Σ^0 LIFE TIME. Dolgov, A. D.; Zakharov, V. I. (Inst. of Theoretical and Experimental Physics, Moscow). Phys. Lett.; 48B: No. 1, 43-44(7 Jan 1974).

A study of $\Sigma \to \Lambda e\nu$ decay would allow for an indirect measurement of Σ^0-hyperon life time. The corresponding effects are estimated and shown to be of the order of 5–10%. The method under discussion seems to be the most accessible way to find the Σ^0-hyperon life time. The validity of the CVC hypothesis is assumed. (auth)

19496 GENERAL CONSTRAINTS ON NEUTRINO–ELECTRON CROSS SECTIONS. Sehgal, L. M. (Technische Hochschule, Aachen). Phys. Lett.; 48B: No. 1, 60-62(7 Jan 1974).

It is shown that in any theory in which weak leptonic processes are induced by an arbitrary number of massive charged and neutral vector intermediate bosons, with couplings satisfying μ-e symmetry, the cross sections for the reactions $\nu_e e \to \nu_e e$, $\bar{\nu}_e e \to \bar{\nu}_e e$, $\nu_\mu e \to \nu_\mu e$ and $\bar{\nu}_\mu e \to \bar{\nu}_\mu e$, expressed in units of $G^2 s/2\pi$, satisfy the constraints (i) $\frac{1}{3} \le \sigma(\bar{\nu}_e e)/\sigma(\nu_e e), \sigma(\bar{\nu}_\mu e)/\sigma(\nu_\mu e) \le 3$, (ii) $\sigma(\bar{\nu}_e e) - \sigma(\bar{\nu}_\mu e) = (\frac{1}{2})[\sigma(\nu_e e) - \sigma(\nu_\mu e)]$, (iii) $[\sigma(\nu_e e) - (\frac{1}{2})\sigma(\bar{\nu}_e e)]^{\frac{1}{2}} - [\sigma(\nu_\mu e) - (\frac{1}{2})\sigma(\bar{\nu}_\mu e)]^{\frac{1}{2}} = \frac{1}{3}$. These relations remain valid in gauge theories containing scalar bosons, as long as the coupling of such bosons to the leptons is proportional to the lepton mass. (auth)

19497 RELATIVISTIC STUDY OF THE REACTION $\nu_\mu + d \to p + p + \mu^-$. Tarrach, R.; Pascual, P. (Univ. of Barcelona). Nuovo Cim.; 18A: No. 4, 760-770(21 Dec 1973).

A calculation of the reaction $\nu_\mu + d \to p + p + \mu^-$ was carried out using the impulse approximation and taking into account the relativistic corrections. The influence of second-class axial currents is considered. The obtained results are compared with the existing experimental data and using a dipolar parametrization for the axial form factor the best fit is obtained for $M_A^2 = 0.71\ (GeV)^2$. (auth)

19498 SPECTRA OF RECOIL ELECTRONS IN $\bar{\nu}_e e^-$ SCATTERING ALLOWING FOR THE INTERFERENCE OF CHARGED AND NEUTRAL CURRENTS. Kerimov, B. K.; Bogdanov, Yu. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1929-1936(Sep 1973). (In Russian).

The angular and energy distributions of recoil electrons in the processes $\bar{\nu}_e + e \to \bar{\nu}_e + e$ and $\bar{\nu}_\mu + e \to \bar{\nu}_\mu + e$ were calculated in lowest order of mixed (V,A) interactions allowing for charged and neutral lepton currents. It was shown that the interference between current interactions $(\bar{e}\nu)$ $(\bar{\nu}e)$ and $(\bar{\nu}\nu)$ $(\bar{e}e)$ can be reduced to enhancement and inhibition of the process of νe scattering. The possibility of verifying the existence of neutral currents $(\bar{\nu}\nu)$ $(\bar{e}e)$ by measurement of the recoil electron spectrum of the $\bar{\nu}_e e \to \bar{\nu}_e e$ reaction by antineutrino beams from nuclear reactors was discussed. (2 figures) (tr-auth)

19499 SPIN CORRELATIONS IN NEUTRINO (ANTINEUTRINO)–ELECTRON SCATTERING AND NEUTRAL LEPTON CURRENTS. Kerimov, B. K.; Bogdanov, Yu. P.; Safin, M. Ya. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1937-1943(Sep 1973). (In Russian).

On the basis of the weak Hamiltonian of (V,A) interactions, containing both the usual charged currents $(\bar{e}\nu)$ $(\bar{\nu}e)$ and neutral currents $(\bar{\nu}\nu)$ $(\bar{e}e)$, the differential cross section for the processes $\nu(\bar{\nu}) + e^- \to \nu(\bar{\nu}) + e^-$ were calculated, allowing for the polarization of the initial and final electrons. (2 tables) (tr-auth)

19500 PRINCIPAL NULL DIRECTIONS OF THE NEUTRINO AND DERIVED MAXWELL FIELDS. Kuchowicz, B. (Univ., Warsaw). Phys. Lett.; 46A: No. 3, 213-214(17 Dec 1973).

Bineutrino fields are constructed from neutrinos described by the two-component Weyl equation. If one demands that the bineutrino fields fulfil the set of Maxwell equations, one has classical version of the "neutrino theory of light". With the help of the spin coefficient formalism, it is established that the energy tensor of the neutrino fields cannot be positively definite, and that the principal null direction of the bineutrino Maxwell fields does not coincide with the principal null direction of the underlying neutrino fields. (auth)

Strong (General)

19501 (COO-1545-137) INCLUDING RESONANCES IN THE MULTIPERIPHERAL MODEL. Pinsky, S. S.; Snider, D. R.; Thomas, G. H. (Argonne National Lab., Ill. (USA)). Oct 1973. 45p. (ANL/HEP-7349). Dep. NTIS $4.25.

A simple generalization of the multiperipheral model (MPM) and the Mueller–Regge Model (MRM) is given which has improved phenomenological capabilities by explicitly incorporating resonance phenomena, and still is simple enough to be an important theoretical laboratory. The model is discussed both with and without charge. In addition, the one channel, two channel, three channel and N channel cases are explicitly treated. Particular attention is paid to the constraints of charge conservation and positivity in the MRM. The recently proven equivalence between the MRM and MPM is extended to this model, and is used extensively. (auth)

19502 (INR-1472) MODEL OF DIFFRACTIVE SCATTERING. Swiecki, M. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

A generalization of Yang diffractive model is proposed to include diffraction dissociation processes. The possibility of multiperipheral diffractive production of particles is considered. Two possible pictures of scattering arise. The peripheral component of pomeron obtained in that way, is, then, favorably compared with experiment. The possibility of increasing cross sections appears in a natural way. (auth)

19503 (RL-73-145) CROSSING SYMMETRY AND COHERENT STATES. Peccei, R. D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Nov 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

It is shown, on general grounds, that the connected T operator can be written in a diagonal form in a coherent state representation. Such an expression automatically yields crossing-symmetric n-particle-matrix elements. This technique is used to establish a connection between dual resonance models and field theory. (auth)

19504 PHENOMENOLOGICAL FAILURE OF SUM RULES FOR INCLUSIVE DISTRIBUTIONS BASED ON PCAC. Masperi, L. (Centro Atomico Bariloche, Argentina). Lett. Nuovo Cim.; 9: No. 1, 19-22(5 Jan 1974).

PCAC is applied to the inclusive processes $pp \to \pi^{\pm}X$, $K^+p \to \pi^-X$, $\pi^-p \to \pi^{\pm}X$; the results are found to be negative in the sense that the sum rules predicted by PCAC are not phenomenologically satisfied. An explanation for the discrepancy of the sum rules is offered; it is concluded that discrepancies in the sum rules should appear for increasing-multiplicity final states and, as a consequence, for the inclusive distributions. (LBS)

19505 GENERATING FUNCTIONS AND PHENOMENOLOGICAL CONSTRAINTS ON TOTAL CORRELATIONS IN INCLUSIVE REACTIONS. Akiyama, Y. (Tokyo Metropolitan Univ.). Lett. Nuovo Cim.; 9: No. 1, 15-18(5 Jan 1974).

Various definitions of the generating functions used to discuss relations between the quantities in inclusive interactions are discussed. Constraints on total correlations are obtained for the cases of $\bar{p}p$, π^-p, π^+p, and K^+p interactions. Model-independent results are obtained which are free from apparent divergences which appeared in the generating functions previously used. (LBS)

19506 FOUNDATION FOR THERMODYNAMICS WITH LARGE FLUCTUATIONS IN HADRONIC MULTIPARTICLE PRODUCTION PROCESSES. Fridman, A. S.; Kuvshinov, V. I.; Potupa, A. S.; Zirkov, L. F. (Inst. of Physics, Minsk, USSR). Lett. Nuovo Cim.; 8: No. 18, 1044-1048(29 Dec 1973).

The problem of constructing suitable statistical methods for the analysis of multiparticle production spectra is considered. Some general criteria to answer the question of whether the analogy between thermodynamics with large fluctuations and multiple generation is possible are discussed. The ideology of the Feynman-Wilson gas model is considered. (LBS)

19507 CONDITIONS FOR THE SELF-CONSISTENCY OF THE MULTIPERIPHERAL MODEL. Benfatto, G. (Univ. L'Aquila, Italy); Rossi, G. C. Nuovo Cim.; 19A: No. 2, 255-264(21 Jan 1974).

In a model-independent formulation of the multi-peripheral integral equation, sufficient conditions are given, allowing an input Regge singularity with $\alpha_{in} = 1$, without violating the Froissart bound. (auth)

19508 COUPLINGS OF THREE EXCITED PARTICLES IN THE DUAL-RESONANCE MODEL. Ademollo, M. (Univ., Florence); Del Giudice, E.; Di Vecchia, P.; Fubini, S. Nuovo Cim.; 19A: No. 2, 181-203(21 Jan 1974).

The vertex operators associated with the transverse states of DRM are explicitly written. As an application of this result the couplings of three excited "transverse" states are explicitly computed. (auth)

19509 MULTIPLICITIES IN CHENG-WU FIELD THEORY. Goldman, T.; Sivers, D. (Stanford Univ., CA). Phys. Lett.; 48B: No. 1, 39-42(7 Jan 1974).

It is noted that the model of Cheng and Wu used to explain high energy hadronic cross sections implies average multiplicities much smaller than those experimentally observed. (auth)

19510 HAGEDORN SPECTRUM DISTRIBUTION AND THE DIMENSION OF HADRONIC MATTER. Dethlefsen, J.; Nielsen, H. B.; Tze, H. C. (Univ. of Copenhagen). Phys. Lett.; 48B: No. 1, 48-50(7 Jan 1974).

Assuming hadronic matter to be an n-dimensional general covariant elastic jelly, its resulting spectrum distribution is shown to be Hagedorn-like independently of n. This provides a counter example to the work of Fubini et al. where such a level density necessitates the one dimensionality of hadrons. (auth)

19511 DUAL MODELS WITH PARA-FIELD EXCITATIONS. Hopkinson, J. F. L. (Daresbury Nuclear Physics Lab., Eng.); Tucker, R. W. Phys. Lett.; 47B: No. 6, 519-522(24 Dec 1973).

A number of new dual resonance models are presented. They are constructed by replacing the usual bose or fermi operators by, or adding to them, operators which satisfy para-statistics commutation relations. Some properties of these amplitudes are outlined. (auth)

19512 EQUIVALENCE BETWEEN THE MUELLER REGGE MODEL AND THE MULTIPERIPHERAL MODEL. Pinsky, S. S.; Snider, D. R.; Thomas, G. H. (Argonne National Lab., Ill.). Phys. Lett.; 47B: No. 6, 505-508(24 Dec 1973).

It is proven that a large class of pionization Mueller Regge models are equivalent to the multiperipheral model. An orthogonal similarity transformation is found which allows one to transform in either direction between equivalent multiperipheral and Mueller models. Models with charge are discussed and the problem of constructing charge conserving Mueller models is solved. (auth)

19513 QUANTUM MECHANICAL TREATMENT OF DECAYING NON-RELATIVISTIC SYSTEMS. Lanz, L.; Lugiato, L. A.; Ramella, G. (Univ., Milan). Int. J. Theor. Phys.; 8: No. 5, 341-352 (1973).

The usual treatment of decaying nonrelativistic particles by means of a nonunitary irreducible representation of the Galilei group is deduced from a suitable formulation of symmetry principles. In such a formulation time translation is distinguished from time evolution; this point is crucial to obtain the irreversible behavior of unstable particles. (auth)

Strong (Baryon No. = 0)

19514 BOUNDS ON THE $\pi\pi$ S-WAVE SCATTERING LENGTHS. Kuehnelt, H. (Univ., Vienna); Grassberger, P. Lett. Nuovo Cim.; 9: No. 2, 59-63(12 Jan 1974).

Lower bounds on the $\pi\pi$ S-wave scattering lengths are obtained, starting from the Jensen-Poisson inequality and forward dispersion relations and using unitarity to obtain the lower bounds in terms of partial waves. Constraints on the bounds are provided by the D-wave scattering lengths calculated from the Froissart-Gribov representation. The analysis is extended to the case of charged pions. It is suggested that more stringent bounds could be obtained by using more refined methods. (LBS)

19515 LOW-ENERGY $\pi\pi$ SCATTERING PARAMETERS. Palou, F. P. (Univ., Autonoma, Madrid); Yndurain, F. J. Nuovo Cim.; 19A: No. 2, 245-254(21 Jan 1974).

The Froissart-Gribov representation and derivatives thereof are used to calculate scattering lengths and effective-range parameters for the lowest (up to and including $l = 4$) $\pi\pi$ partial waves. The results are discussed. (auth)

19516 SCALING IN PRONG-NUMBER DISTRIBUTION IN $\bar{p}p$ COLLISIONS. Rama Rao, I. (Tata Inst. of Fundamental Research, Bombay); Sarma, K. V. L. Pramana; 1: No. 2, 66-69(Aug 1973).

The prong-number distributions in $\bar{p}p$ collisions at relatively low laboratory momenta ($\lesssim 7$ GeV/c) exhibit the same type of scaling which has been observed in pp and π^-N collisions at momenta $\gtrsim 50$ GeV/c. (auth)

19517 OPTIMAL EXTRAPOLATION OF $\pi-\pi$ AMPLITUDES AROUND $\nu = t = 0$. Gensini, P. (Univ., Lecce, Italy); Paver, N.; Verzegnassi, C. Phys. Lett.; 47B: No. 6, 515-518(24 Dec 1973).

$\pi-\pi$ amplitudes up to 1150 MeV cm energy are extrapolated to zero lab. energy for different values of t around $t = 0$ employing the optimally weighted dispersion relations proposed by Ciulli and Fischer. The results agree with the predictions of soft-pion theory. (auth)

19518 FORMATION OF POLARIZED NEUTRAL VECTOR MESONS IN OPPOSED e^+-e^- BEAMS. Ablakulov, Kh. A.; Gulyamov, U. G. (Inst. of Nuclear Physics, USSR). Dokl. Akad. Nauk Uzb. SSR: No. 6, 30-33(1973). (In Russian).

Expressions were obtained for the differential and total cross sections of the $e^+ + e^- \to \nu(p,w,d) + \gamma$ reaction with consideration of the dipole and quadrupole polarization of the ν mesons formed and the circular polarization of the emitted photons. The tensor components of the quadrupolarization of the ν mesons were also calculated in the case of an arbitrary emission angle. (JSR)

19519 MULTIPLICITY MOMENTS AT LOW AND HIGH ENERGY IN HADRON-HADRON SCATTERING. Antich, P. (Univ., Pavia, Italy); Calligarich, E.; Cecchet, G.; Dolfini, R.; Impellizzeri, F.; Ratti, S.; Giovannini, G. Lett. Nuovo Cim.; 9: No. 3, 91-99(19 Jan 1974).

A phenomenological investigation is made of the relation obtained by Weingarten for the multiplicity moments in hadron-hadron interactions. The predictions are compared with moments computed from the experimental data, over a wide energy range, of the reactions pp, $\bar{p}p$, π^+p, and K^+p. (LBS)

19520 SCALING PROPERTIES OF CHARGED MULTIPLICITY DISTRIBUTIONS. Baier, R. (Univ., Graz); Widder, F. Lett. Nuovo Cim.; 9: No. 3, 105-111(19 Jan 1974).

The scaling behavior of charged multiplicity distributions is investigated for inelastic pp, π^+p, π^-p, K^+p, and K^-p interactions. (LBS)

19521 WKB APPROXIMATION FOR THE DUFFIN-KEMMER EQUATION FOR SPIN ZERO PARTICLES. Pardy, M. (Univ., Brno). Acta Phys. Slovaca; 23: No. 1, 13-19(1973).

An equivalent system of equations for the Duffin-Kemmer equation for spin-zero particles is derived, the WKB approximation is performed in this system and the Lorentz equation is derived. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 19835.

19522 (INP-840) METHOD OF ESTIMATING THE CROSS SECTIONS FOR RESONANCE PRODUCTION. Eskreys, A.; Figiel, J.; Malecki, P.; Zalewska, A.; Zalewski, K. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

A simple method for the estimation of cross-sections for simple or double resonance production is presented. (auth)

19523 (JINR-E2-7556) QUASIPOTENTIAL APPROACH AND BACKWARD πN SCATTERING AT HIGH ENERGY. Dzhgarkava, M. I.; Garsevanishvili, V. R.; Goloskokov, S. V.; Kazarinov, Yu. M.; Matveev, V. A.; Potashnikova, I. K.; Silin, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

Statistically satisfactory description ($\chi^2/\overline{\chi}^{-2} = 0.94$, C.L. = 69%) of the known experimental data on backward πN scattering in the region $-2.86\ (GeV/c)^2 \leq u \leq 0.06\ (GeV/c)^2$ and $P_L \gtrsim 7.8$ GeV/c is obtained in the framework of the quasi-potential approach. The predictions for higher values of P_L are also given. (auth)

19524 (RL-73-149) COMMENT ON REAL PARTS OF KN AND $\overline{K}N$ ELASTIC AMPLITUDES. Phillips, R. J. N. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Dec 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

It is observed that $K_L^0 N \to K_S^0 N$ regeneration measurements contain information about forward real parts, which has not been exploited hitherto, and which disagrees with some of the present Coulomb interference results. Charge exchange scattering also contains real part information, not measured by other means. (auth)

19525 DYNAMICS OF THE D_{13} WAVE IN πN SCATTERING. Gustafson, G. (Univ. of Lund, Sweden). Nucl. Phys.; B66: 182-188(1973).

Earlier the interactions in the ρN and $\pi\Delta$ systems were studied. These analyses include predictions about the forces in those partial waves which couple to the πN D_{13} wave. Although the many channels and strong forces which are involved in this wave make a quantitative prediction difficult it is shown that the qualitative predictions are in good agreement with πN elastic phase-shift analyses and with the Berkeley-SLAC analysis of the reaction $\pi N \to \pi\pi N$. The interactions in the πN and ρN systems combine to give the resonance $D_{13}(1520)$ whereas the attraction in the $\pi\Delta$ D-wave system produces a resonance around 1700 MeV which however does not couple strongly to the πN system. (auth)

19526 s-CHANNEL PROFILE FACTOR MODEL FOR REGGE-ρ EXCHANGE AND DUALITY IN $\pi^-p \to \pi^-\Delta^+(1236)$ AND $\pi^+p \to \pi^0\Delta^{++}(1236)$. Heckman, P. E.; Henzi, R. (McGill Univ., Montreal). Can. J. Phys.; 51: No. 16, 1693-1700(15 Aug 1973).

The results of an analysis of differential cross sections and isobar density matrix elements in isobar production $\pi^-p \to \pi^-\Delta^+(1236)$ and $\pi^+p \to \pi^0\Delta^{++}(1236)$ are presented using an s-channel profile factor model for Regge-ρ exchange previously tested in $\pi^-p \to \pi^0n$. Implications for future experiments are discussed. (auth)

19527 MAGNITUDE OF THE PARITY-VIOLATING NUCLEON-PION COUPLING N_-^0, AND FINAL-STATE INTERACTIONS. Reid, J. H. (Ruhr-Univ., Bochum, Ger.). Lett. Nuovo Cim.; 9: No. 2, 41-45(12 Jan 1974).

A new estimate is presented for the magnitude of the parity-violating amplitude $N \to p\pi^-$ based on the inclusion of final-state interactions. It is shown that the inclusion of final-state interactions significantly modifies the older estimate for N_-^0 based on the current-algebra-PCAC method. (LBS)

19528 QUASI-TWO-BODY REACTIONS $0^-\frac{1}{2}^+ \to 0^-\frac{1}{2}^+$ AT HIGH ENERGY. de Brion, J. P.; Lewin, C. (CEN, Saclay, France). Nuovo Cim.; 19A: No. 2, 225-244(21 Jan 1974).

Statistics of quasi-two-body channels involving production of Δ and Y^* at high energy have become appreciable. A Regge model is fitted to the group of reactions $\pi^+p \to \pi^0\Delta^{++}$, $\pi^+p \to \eta\Delta^{++}$, $\pi^-p \to \pi^-\Delta^+$, $K^+p \to K^0\Delta^{++}$, $K^-n \to \overline{K}^0\Delta^-$, and to the reactions $\pi^+p \to K^+Y^{*+}$ and $K^-p \to \pi^-Y^{*+}$. Exchange degeneracy of the poles ρ (K^*) and A_2 (K^{**}), SU_3 octet symmetry and dominance of the magnetic dipole coupling M1 are included in this analysis. A cut with three supplementary parameters is introduced in order to interpret the differences of the cross-sections of reactions $K^0\Delta^{++}$ and $\overline{K}^0\Delta^-$, π^-Y^{*+} and K^+Y^{*+}. The cut, moreover, allows one to better fit the polarization data of the channel $\pi^0\Delta^{++}$, which are, at small $|t|$, inside the physical domain and not compatible with a single-pole exchange. The effective trajectories of the reactions are in general different from those of the poles, and the cut allows a better simulation of the experimental trajectories. The SU_3 symmetry involving the exchange of octet trajectories is quite well satisfied for reactions exchanging poles of the same strangeness, but is strongly broken otherwise. In the latter case, it is nevertheless shown that the residues of the poles are compatible with SU_3. Finally, the hypothesis of M1 dominance is generally acceptable for all reactions, except for $\pi^0\Delta^{++}$ at small transfer. (auth)

19529 UNITARITY AND CURRENT ALGEBRA CONSTRAINTS IN A LOW-ENERGY Kπ MODEL. Komen, G. J. (CERN, Geneva). Nuovo Cim.; 19A: No. 2, 265-278(21 Jan 1974).

A crossing-symmetric model for low-energy πK scattering is investigated. The model satisfies elastic unitarity to a good approximation, on and off the mass shell. With some minimal additional input from current algebra, s-wave phase shifts and p-wave scattering lengths are determined. A comparison is made with further current algebra theorems including those arising from the (3*,3) + (3,3*) symmetry-breaking scheme. (auth)

19530 PION-NUCLEON SCATTERING IN THE BACKWARD HEMISPHERE. Donnachie, A. (Univ. of Manchester, Eng.); Thomas, P. R. Nuovo Cim.; 19A: No. 2, 279-293(21 Jan 1974).

A model is constructed for pion-nucleon scattering in the backward hemisphere, based on Regge poles plus a coherent background ascribed to quark re-arrangement processes. The model provides a good description of most of the existing data. (auth)

19531 DETERMINATION OF THE REAL PARTS OF THE KAON-NUCLEON FORWARD-SCATTERING AMPLITUDES. Conti, A. (Univ., Lecce, Italy); Ladiana, P. Lett. Nuovo Cim.; 9: No. 1, 1-3(5 Jan 1974).

A new attempt is made to determine the sign of the real part of the K^+p forward scattering amplitude $D_+(\omega)$, starting from the dispersion relation first introduced by Gilbert for the πN scattering amplitude. Preliminary results of the computation are summarized in the following way: $D_-(\omega) - D_+(\omega)$ assumes an average value of 2.5 fm (equivalent to 12.5 $(GeV)^{-1}$) for the kaon laboratory energy in the range from 1.65 to 5.00 GeV. The average value does not depend greatly on the low-energy parameterization of the K^-p data and on the corresponding values of the coupling constants. (LBS)

19532 SCALING RELATION BETWEEN πN AND KN($\overline{K}N$) ELASTIC SCATTERING. Kohsaka, Y. (Tohoku Univ., Sendai); Takagi, F. Lett. Nuovo Cim.; 8: No. 17, 997-1000(22 Dec 1973).

A simple scaling relation is derived between the differential cross sections for πN and KN ($\overline{K}N$) elastic scattering, which provides a simultaneous explanation for the existence of the second dip in πN elastic scattering and the absence of a corresponding dip in KN and $\overline{K}N$ elastic scattering. The main ingredients used are 1) the dual geometrical model, 2) absence of exotic resonance, and 3) a geometrical scaling. (LBS)

19533 FORWARD DISPERSION RELATION FOR πN CHARGE EXCHANGE. Bugg, D. V.; Carter, A. A. (Queen Mary Coll., London). Phys. Lett.; 48B: No. 1, 67-68(7 Jan 1974).

The connection between the πN scattering lengths and the forward charge exchange amplitude at high energies is discussed. It is shown that an apparent discrepancy with the forward dispersion relation may be explained by the effect of the Coulomb barrier on total cross sections at intermediate energies. With this correction, the data are now consistent with the unsubtracted dispersion relation. (auth)

19534 KN CHARGE EXCHANGE AMPLITUDES AND POLARIZATIONS IN TERMS OF DISPERSION RELATIONS AND DUAL ABSORPTIVE REQUIREMENTS. Agyres, E. N. (State University Coll., Plattsburgh, NY); Contogouris, A. P.; Holden, T. P. Lett. Nuovo Cim.; 8: No. 17, 969-976(22 Dec 1973).

The helicity flip and nonflip amplitudes and the polarizations of the line-reversed $K^+n \to K^0p$ and $K^-p \to \overline{K}^0n$ are calculated at two characteristic values of the momentum transfer $\sqrt{-t}$: $t = t_0 = -0.175$ $(GeV)^2$ and $t = t_1 = -0.5$ $(GeV)^2$. The method makes use of certain general requirements of the dual absorptive model and of fixed-t

dispersion relations. The results are in agreement with very recent experimental data on $K^-p \to \bar{K}^0n$ polarization at 8 GeV. (LBS)

19535 QUASI-TWO-PARTICLE MESON–NUCLEON INTERACTIONS AND SU(3) SYMMETRY. Masleev, N. N. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 42-47(1973). (In Russian).

The processes of the scattering of mesons on nucleons with formation of nucleon isobars, belonging to the decuplet of the SU(3) group, were examined. The general form of the amplitudes for processes of the octet + octet → octet + decuplet type in the SU(3) symmetry and during its breakdown was obtained. The relations between amplitudes and cross sections of concrete processes were obtained and compared with experiment. The experimental data indicated symmetry breakdown and the relation between cross sections obtained with consideration of the SU(3) symmetry breakdown agree well with experiments. (tr-auth)

19536 SPIN–PARITY ANALYSIS OF THE B MESON. Chung, S. U. (Brookhaven National Lab., Upton, NY); Protopopescu, S. D.; Lynch, G. R.; Alston–Garnjost, M.; Barbaro-Galtieri, A.; Friedman, J. H.; Ott, R. L.; Rabin, M. S.; Solmitz, F. T.; Flatte, S. M. Phys. Lett.; 47B: No. 6, 526-530(24 Dec 1973).

A J^P analysis of the low-mass $\pi^+\omega$ system was performed using the reaction $\pi^+p \to \pi^+\omega p$ at 7.1 GeV/c. (auth)

19537 COHERENT PHOTOPRODUCTION OF PIONS ON NUCLEI AND THE CROSS SECTION OF THE ρN INTERACTION. Magzumov, E. Zh.; Rasulov, R. R.; Sharapov, N. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 48-51(1973). (In Russian).

Within the framework of the Glauber model the differential cross section of the process of coherent photoproduction of two-pion systems was analyzed. From a comparison with experimental data conclusions were made on the dominant role of the mechanism of the formation of ρ mesons with a cross section for the interaction with the nucleons of nucleus-target of the order of 25 mb. (tr-auth)

19538 FESR FOR SOFT-PION AMPLITUDES, OR THE ZERO-ENERGY THEOREMS REVISITED. Gensini, P. (Univ., Lecce, Italy). Nuovo Cim.; 18A: No. 4, 697-710(21 Dec 1973).

The Adler treatment of the off-mass-shell corrections to pion–nucleon forward amplitudes has been re-examined in the light of the new experimental data. This treatment is found to be consistent both with the experimental knowledge on $|g_A|$ and with the chiral-symmetry-breaking scheme of Gell-Mann, Oakes and Renner, in whose framework it had previously been employed to evaluate the kaon-nucleon sigma-term. (auth)

19539 INCREASE OF TOTAL CROSS SECTIONS AND SLOPE OF DIFFRACTION PEAK. Solov'ev, L. D. (Inst. of High Energy Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 268-271(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 455-457(5 Oct 1973).

Predictions for the behavior of the total cross sections are obtained on the basis of the available experimental data on hadron–hadron collisions and the general principles of quantum field theory. (auth)

19540 STRUCTURE OF THE PROTON. Feynman, R. P. (California Inst. of Tech., Pasadena). Science; 183: No. 4125, 601-610(15 Feb 1974).

The review of proton structure covers an introduction to the hadrons, kinds of interactions in physics today, principles guiding the analysis of experiments, hadron property classification, regularities observed in hadron properties: a decimet, the quark model, the octet, mesons, hadrons of higher energy, attempts to calculate hadron properties, quark pair production, studying the parts of a proton: electron scattering from a proton, and neutrino scattering from a proton. (JFP)

19541 DETERMINATION OF HIGH ENERGY ω NONFLIP AMPLITUDE. Godreche, C.; Navelet, H. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 9: No. 3, 65-70 (19 Jan 1974).

An amplitude analysis is made of the two elastic reactions $K^+p \to K^+p$ and the two charge-exchange reactions $K^-p \to \bar{K}^0n$ and $K^+n \to K^0p$. The domain of values of the imaginary and real parts of the ω nonflip amplitude is plotted. A behavior of ω_{++} very similar to that of ξ_{++} in πN is found to be compatible with the experimental data. (LBS)

19542 SYMMETRIC QUARK MODEL ANALYSIS OF THE MASSES AND DECAY RATES FOR (70,1⁻)-STATES. Jones, M. (Univ. of Chicago); Levi Setti, R.; Lasinski, T. Nuovo Cim.; 19A: No. 3, 365-394(1 Feb 1974).

The (70,1⁻)-representation of $SU_6 \times O_3$ was re-analyzed using the symmetric quark model of Greenberg and Resnikoff and the most recent experimental information. The eleven parameters of the model mass formula are determined by χ^2-minimization, and predictions are obtained for the masses and mixings of all (70,1⁻)-states. With these predictions and the assumption that decays are invariant under $SU_{6W} \times O_{3LZ}$, partial widths for all decays of (70,1⁻)-states into baryons in (56, 0⁺) and pseudoscalar mesons in (35, 0⁻) are computed and compared to experimental values. The predictions for S-wave decays are in serious disagreement with experiment but the predictions for D-wave decays, with one exception, are a reasonable first approximation in an average sense to the observed values. A good fit to the masses and D-wave decay rates could not be obtained simultaneously. Therefore, either the mass formula does not correctly give the mixing of the states or $SU_{6W} \times O_{3L_Z}$ is violated in the decays. (auth)

19543 STATISTICAL ISOSPIN MODEL AND CROSS SECTIONS OF REACTIONS $\pi^-p \to N + (2, \ldots, 6)\pi$ WITHIN THE 1 TO 16 GeV ENERGY RANGE. Vinogradov, V. B. (Joint Inst. for Nuclear Research, Dubna, USSR); Kutsidi, N. K.; Martinska, G.; Sandor, L. Acta Phys. Slovaca; 23: No. 1, 39-47(1973).

Using a statistical isospin model as a basis, cross section ratios were calculated for different final charge states of the $\pi^-p \to N + (2, \ldots, 6)\pi$ reactions. A comparison of the model predictions with the experimental data for these reactions was performed at various energies of incident π^--mesons. It was shown that the statistical isospin model predicted ratios between the reaction cross sections $\pi^-p \to N + (2, \ldots, 6)\pi$ within the 1 to 16 GeV energy range with an accuracy of ≈ 10%. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 19610 and 19611.

19544 CHARGED-PRONG DISTRIBUTIONS IN PROTON–PROTON COLLISIONS IN THE (50 TO 300) GeV/c MOMENTUM RANGE USING THE GRAM–CHARLIER EXPANSION. Heiko, L.; Hvegholm, J. (Univ. Veracruzana-Xalapa, Mexico). Lett. Nuovo Cim.; 8: No. 17, 977-982(22 Dec 1973).

A fit was made to Serpukhov and NAL data on proton–proton interactions at 50 to 303 GeV/c using the charged-prong distribution given by the Gram–Charlier asymptotic expansion. Moment ratios are also calculated using the universal fit and the results are found to be in excellent agreement with experiment. (LBS)

19545 DOUBLE HYPERNUCLEI AND THE ΛΛ INTERACTION. Bhamathi, G. (Univ. of Madras); Prema, K.; Seshadri, I. Pramana; 1: No. 6, 274-287(Dec 1973).

The double hypernuclei ${}_{\Lambda\Lambda}He^6$ and ${}_{\Lambda\Lambda}Be^{10}$ were analyzed by using a purely attractive nonlocal separable potential. These double hypernuclei were considered as three-body ($\Lambda + \Lambda + \alpha$) and four-body ($\Lambda + \Lambda + \alpha + \alpha$) systems, respectively. A consistent description of both the systems was obtained for an intrinsic range b = 1.5 fm of the ΛΛ interaction in the ${}^1S_0$ state. For the purely attractive Yukawa potential this corresponds to the two-pion-exchange range. The strength of the ΛΛ interaction deduced from the double hypernuclei was found insufficient to bind the two-body ΛΛ system. The lightest double hypernucleus that is expected to be bound is ${}_{\Lambda\Lambda}H^5$. The heavier double hypernuclei ${}_{\Lambda\Lambda}C^{14}$ and ${}_{\Lambda\Lambda}O^{18}$ were also analyzed. The binding energies obtained are in reasonable agreement with those of earlier workers. (auth)

19546 DETERMINATION OF THE ωpp COUPLING CONSTANT USING pp FORWARD DISPERSION RELATION. Verwest, B.; Riska, D. O. (State Univ. of New York, Stony Brook). Phys. Lett.; 48B: No. 1, 17-21(7 Jan 1974).

The ωpp coupling constant is determined by representing the discontinuity across the unphysical cut in the pp forward dispersion relation by one-meson and two-pion-exchange terms. The real part of the forward pp amplitude is computed from pp phase shifts below 460 MeV lab. kinetic energy. For the ωpp coupling constant the values $g_\omega^2/4\pi \approx 10 \pm 1.2$ are found. (auth)

19547 INELASTIC INTERACTIONS OF FAST HADRONS WITH NUCLEI. Kancheli, O. V. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 274-277(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 465-469(5 Oct 1973).

The picture of the inelastic processes accompanying the interaction of a fast hadron with a nucleus is considered under the assumption that the interaction of two hadrons is described by means of a pomeron exchange and that the asymptotic total cross sections are constant in this case. (auth)

19548 COLLIDING POLES AND GROWING CROSS SECTIONS. Zotov, N. P.; Starkov, N. I.; Tsarev, V. A. (Lebedev Inst. of

Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 271-274(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 460-464(5 Oct 1973).

The growth of the total cross sections and other features of pp scattering, observed in high-energy experiments, are discussed on the basis of the assumption of colliding complex Regge poles. (auth)

19549 HIGH-ENERGY PHYSICS AND PROTON–PROTON SCATTERING. Cocconi, G. (European Organization for Nuclear Research, Geneva). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 409-420(31 Dec 1973).

After a brief description of the aims of high-energy physics and of the general properties of strong interactions, a simplified account is given of elastic proton–proton scattering by Coulomb and by strong interaction forces. The relation of diffraction dissociation to elastic scattering is also discussed. (auth)

19550 THEORETICAL MODELS OF PROTON–PROTON SCATTERING. Phillips, R. J. N. (Science Research Council, Abingdon, Eng.). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 485-501 (31 Dec 1973).

A brief survey is made of the most popular or recent models of p-p elastic scattering, including Regge-pole and dual models, various parametrizations of the pomeron, and scaling models for deep elastic scattering. (auth)

19551 ASPECTS OF THE FUNDAMENTAL THEORY OF PROTON–PROTON SCATTERING. Martin, A. (European Organization for Nuclear Research, Geneva). Proc. Roy. Soc. (London), Ser. A; 335: No. 1603, 503-507(31 Dec 1973).

After recalling the existence of a high energy bound on proton–proton total cross sections, the various phenomena are discussed which occur when these cross sections rise and especially when they have the qualitative behavior of the bound : rising elastic cross sections, shrinking diffraction peak, validity of the Pomeranchuk theorem for total and elastic cross sections, and existence of a positive real part of the forward amplitude at high energies. (auth)

19552 BEHAVIOR OF LARGE-ANGLE pd → dp SCATTERING WITH ENERGY. Bhakar, B. S. (Univ. of Manitoba, Winnipeg). Nuovo Cim.; 18A: No. 4, 737-746(21 Dec 1973).

A discussion is presented of the energy-dependent behavior of the proton–deuteron elastic scattering at $\theta_{cm} = 180°$. It is shown that the interference between S and P waves is mainly responsible for the low-energy peak. It is also pointed out that the present-day experimental information is not sufficient to support or rule out the alternative explanations for the higher-energy peak. (auth)

19553 N–N AMPLITUDE IN THE PERTURBATIVE AND THE FERMI BASES. Leo, R. A. (Univ., Lecce, Italy); Soliani, G.; Minguzzi, A. Nuovo Cim.; 18A: No. 4, 675-682(21 Dec 1973).

The analyticity of the perturbative invariant amplitudes for the N–N process is discussed starting from an observable quantity which surely exists for each $t \leq 0$. It is shown that such amplitudes can have a kinematical pole at $t = 0$. Furthermore, it is proved that the Fermi invariant amplitudes are regular in s for $t \leq 0$. Finally, some constraints for the residues of the perturbative amplitudes at $t = 0$ are deduced. (auth)

19554 FIELD THEORY MODEL FOR FIXED ANGLE PROTON–PROTON SCATTERING. Halliday, I. G.; Huskins, J.; Sachrajda, C. T. (Imperial Coll. of Science and Tech., London). Phys. Lett.; 47B: No. 6, 509-511(24 Dec 1973).

It is argued that the sum of the leading terms to each order in the coupling constant in massive Q.E.D. at fixed angle leads to the elastic cross section $d\sigma/dt = A(\theta)s^{-2}\exp(a\ln^2 s + b(\theta)\ln s)$. This gives good agreement with the data for wide angle proton–proton scattering. (auth)

19555 COMPLEX REGGE POLES AND HIGH ENERGY SCATTERING DATA. Chan, C. F.; Chen, C. K.; Rarita, W. (Univ. of California, Berkeley). Phys. Lett.; 47B: No. 6, 512-514(24 Dec 1973).

For the high energy data on σ_{tot}^{pp} the proton–proton total cross section, and on ρ, the ratio of real to imaginary part of the forward elastic amplitude, including the recent ISR results, an excellent fit is obtained with P, P', ω Regge poles plus a pair of complex conjugate Regge poles. The complex poles describe the possible oscillatory behavior of the quantities σ_{tot}^{pp} and ρ. The physical meaning of these complex poles and extrapolation to future measurements of the above quantities are discussed. (auth)

19556 NUCLEAR INTERACTIONS BY HIGH-ENERGY COSMIC RAY NUCLEI WITH LIGHT NUCLEI IN EMULSION. Imaeda, K.; Fleming, P. (Dublin Inst. for Advanced Studies). J. Phys., A (London); 6: No. 12, 1974-1989(Dec 1973).

The mechanism of particle production in nucleus–nucleus and nucleus–nucleon collisions produced by high energy cosmic ray nuclei ($6 \leq Z \leq 26$) in nuclear emulsion was studied. Theoretical formulas to estimate the lntan θ distributions of the individual groups of secondaries were derived and used for the analysis. It is found that a large proportion of relativistic α particles and protons are produced through the knock-on process as distinct from the fragmentation process. Kaplon's formulas (Phys. Rev.; 85: 295-309 (1952)) and the one presently proposed for the fragmentation α particles or protons if applied to all the relativistic α particles or protons, would give an underestimation of the primary energy. Mesons are produced more through the isobar than the fireball process in the primary energy interval from 10 to 30 GeV/nucleon, but the meson multiplicity due to the latter process increases faster with increasing energy than for the former process. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 19442.

19557 INFINITE-DIMENSIONAL ALGEBRA OF GENERAL COVARIANCE GROUP AS THE CLOSURE OF FINITE-DIMENSIONAL ALGEBRAS OF CONFORMAL AND LINEAR GROUPS. Ogievetskii, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 8: No. 17, 988-990(22 Dec 1973).

It is proved that the algebra of the general covariance group $x_i = f_i(x_1, x_2, x_3, x_4)$ turns out to be the closure of algebras of the linear and conformal groups, i.e. that any generator of the general covariance group is representable as some linear combination of repeated commutators of generators $SL_{4,R}$, and C_{15}. (LBS)

19558 EXTENSIONS OF THE ALGEBRA OF POINCARE GROUP GENERATORS BY BISPINOR GENERATORS. Gol'fand, Yu. A.; Likhtman, E. P. (Lebedev Inst. of Physics, Moscow). pp 37-44 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Specific extensions of the algebra of Poincare group generators by bispinor operators are considered leading to algebras which have no reflection in a plane. Properties of these algebras are correlated with the symmetry properties of physical systems, in particular, with the problem of parity non-conservation in weak interactions. (auth)

19559 DISCRETE SUBGROUPS OF THE POINCARE GROUP. Dirac, P. A. M. (Univ. of Miami, Coral Gables, FL). pp 45-51 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972).

The discrete subgroup of the Lorentz group is studied which gives a subgroup of the Poincare group when discrete translations are added. The simplest four-dimensional lattice is considered, which is a generalization of the three-dimensional cubic lattice. (auth)

19560 ALGEBRAIC REALIZATION OF THE CHIRAL SU(3) × SU(3)-SYMMETRY. Ogievetskii, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 224-241 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The dynamical chiral symmetry SU(3) × SU(3) with the linearization on the subgroup of isotopic spin and hypercharge SU(2) × Y is considered. The total symmetry is broken spontaneously, but it algebraic properties are restored if one assumes that amplitudes of collinear processes in the tree-approximation have good asymptotic limits at high energies. It is shown that particles with a given helicity must be classified according to representations of the chiral group SU(3) × SU(3). In that case the squared m ss operator can have except of its invariant part an admixture of the zeroth and eighth components of (3,3*) + (3,3*)-representation in accordance with the hypothesis of Gell-Mann–Oakes–Renner. The smallness of these components is not required. (auth)

19561 LOCAL GENERATORS FOR THE LORENTZ GROUP IN THE $P(\varphi)_2$ MODEL. McBryan, O. A. (Univ. of Toronto). Nuovo Cim.; 18A: No. 4, 654-662(21 Dec 1973).

Self-adjointness of the local energy, momentum and Lorentz-boost densities in the $P(\varphi)_2$ quantum field model is proved. It is also shown that these generators yield and correct $P(\varphi)_2$ dynamics. (auth)

19562 FIXED POINT THEOREM FOR THE POINCARE GROUP. Mainland, G. B.; O'Raifeartaigh, L. (Dublin Inst. for Advanced Studies). Int. J. Theor. Phys.; 8: No. 6, 465-471(1973).

The fixed points for an arbitrary proper Poincare transformation are found by exploiting the homomorphism between the Lorentz group and SL(2,C). (auth)

Applications (Electromagnetic and Weak)

19563 PSEUDOSCALAR-MESON MASS SHIFT IN THE SPONTANEOUSLY BROKEN U_3 GAUGE THEORY. Hosoya, A. (Osaka Univ.). Lett. Nuovo Cim.; 9: No. 3, 88-90(19 Jan 1974).

A model of hadronic U_3-symmetry-breaking mechanism was previously proposed where the three triplets of scalar mesons play inportant roles in the Higgs–Kibble phenomena. The self-energies of the octet pseudoscalar mesons to the second-order approximation in perturbation are computed. It is shown that each mass difference does not converge, while the correction to the Okubo–Gell–Mann mass formula is finitely obtained and is found to be of order ϵ^2, where ϵ is an SU-3 breaking parameter. (LBS)

Applications (Strong)

Refer also to abstract 19542.

19564 GENERAL CHIRAL $SU_2 \times SU_2$ LAGRANGIAN AND REPRESENTATION MIXING. Ebrahim, A.; Guersey, F. (Middle East Tech. Univ., Ankara). Lett. Nuovo Cim.; 9: No. 1, 9-14 (5 Jan 1974).

The representation mixing problem for SU(2) × SU(2) symmetry is discussed in the framework of the general nonlinear chiral SU(2) × SU(2) invariant pion–nucleon Lagrangian. It is shown that the structure of the chiral invariant pion–nucleon Lagrangian allows a description of the chiral property of the π, ρ, ϵ, and A_1 mesons in terms of certain vector, axial-vector, and scalar pion functions in such a way that the representation mixing scheme found phenomenologically by Gilman and Harari can be obtained without the necessity of fixing the mixing angle experimentally. It is further shown that the charges associated with pion functions that describe the chiral property of these mesons constitute the ten generators of the noncompact $SO_{4,1}$ group, which may be regarded as the conformal group in three-dimensional isospin space. The mass operator is found to transform as a mixture of a scalar and a vector with respect to the chiral SU(2) × SU(2) group. (LBS)

Scattering Theory

Refer also to abstracts 19360, 19435, and 19893.

19565 DIVERGENCE-FREE S-MATRIX THEORY IN THE INSTANT FORM. Kamoi, K. (Tokyo Univ.). Lett. Nuovo Cim.; 8: No. 18, 1001-1006(29 Dec 1973).

A model of divergence-free S-matrix is obtained by working with Dirac's instant form of dynamics. In this form the Poincare-group generators G_α are given in such a way that the energy P_0 and the boost operators K_i contain essential, dynamical terms, whereas the momentum P_i and the angular momentum J_i consist only of trivial kinematical terms. (LBS)

19566 SATURATION OF FINITE-ENERGY SUM RULES FOR HIGHLY SINGULAR POTENTIALS AND RISING REGGE TRAJECTORIES. Misra, R. C. (Univ. of Nigeria, Nsukka). Lett. Nuovo Cim.; 9: No. 2, 46-48(12 Jan 1974).

The saturation condition for rising Regge trajectories $\alpha(s) \sim (s \ln s)^{1/2}$ is derived with the intercept of the ρ-trajectory = $\frac{1}{2}$, starting from the consistency condition, due to Mohapatra, for finite-energy sum rules for highly singular potentials. (LBS)

19567 RELATIONS BETWEEN THE HIGH ENERGY SCATTERING CROSS SECTIONS IN THE SHELL-PARTICLE MODEL. Wu-li; 2: No. 2, 75-79(May 1973).

On the basis of the relativistic strong-particle structural model—the shell–particle model—a study was made of the relations between the high-energy scattering cross sections. The assumptions of the analysis are first described. Expressions are derived for the relations between the differential cross sections of the quasi-two-body reaction. The results are compared with those derived from the nonrelativistic quark model. (JPRS)

19568 NON-COUPLED INTEGRAL EQUATIONS FOR N-PARTICLE SCATTERING. Pao, C. K. (Inst. of High Energy Physics, Peking). Wu-li; 2: No. 3, 150-151(Aug 1973).

A method to obtain the scattering solution of many-body Schrodinger equations is proposed. Derivations for 3-body and 4-body problems are given. Generalization to n-body problem is presented. A property of this method is that the integral equations can be solved successively and independently, thus avoiding the usual difficulty of coupled integral equations. (auth)

19569 THRESHOLD BEHAVIOR OF PARTIAL-WAVE AMPLITUDES: REVISITED. Aly, H. H.; Hill, R. C. (Southern Illinois Univ., Edwardsville). Particles Nucl.; 6: No. 2-3, 86-90 (1973).

A derivation is given of the well established threshold behavior of partial wave amplitudes $\tan \delta_l \sim k^{2l+1}$, which seems to be quite independent of the model adopted. The implications of this derivation are discussed. (LBS)

19570 PRODUCTION MECHANISMS OF TWO-TO-TWO SCATTERING PROCESSES AT INTERMEDIATE ENERGIES. Fox, G. C. (California Inst. of Tech., Pasadena); Quigg, C. Contract AT(11-1)-68. Annu. Rev. Nucl. Sci.; 23: 219-313(1973).

The qualitative features of peripheral and Regge ideas are summarized, and the formalism is detailed. A critical review is given of the many amplitude analyses of πN and hypercharge exchange reactions. The experimental systematics of forward scattering are listed, and their theory outlined. (JFP)

19571 EXTENSION OF ROY'S EXACT PARTIAL-WAVE EQUATIONS TO ANY ENERGY. Lopez, C. (Universidad Autonoma de Madrid). Nuovo Cim.; 18A: No. 4, 794-804(21 Dec 1973).

A method to continue analytically Roy's equations to any energy is investigated. The supplementary conditions to perform such a continuation are Mandelstam representation with a finite number of subtractions and some other rather weak conditions on the double-spectral functions. The fact that the continuation has to be performed after quite tedious calculations and the difficulties with the estimation of errors are the main disadvantages of the method. On the other hand, it provides a complete test of analyticity, crossing and unitarity for a partial-wave set without any limitations in energy. (auth)

19572 UNITARITY WITHOUT THE OPTICAL THEOREM. Kupczynski, M. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 9: No. 4, 134-136(26 Jan 1974).

It is pointed out that the optical theorem derived from conservation of probability is based also on some additional less obvious assumptions which can, but not necessarily need, be true for high-energy strong interactions. A discussion is centered on these assumptions: (1) the purity of the initial ensemble of two-particle states; and (2) the interference of the amplitude for the free motion with the forward scattering amplitude. It is argued that neither of these assumptions is obvious and both require experimental verification. (LBS)

19573 SHORT-RANGE TRANSPARENT POTENTIALS. Razavy, M. (Univ. of Alberta, Edmonton). Nuovo Cim.; 18B: No. 2, 237-246(11 Dec 1973).

In classical mechanics the asymptotes of the trajectory, rather than the exact path of the particle in the interaction region, determine the differential cross section. If a potential causes a localized distortion of the orbit of a particle without changing the asymptotes of the trajectory, then such a potential is transparent and has no observable effect in a scattering experiment. However, if one determines the path of the particle, or measures the time delay caused by the passage of the particle through the potential, then in general, it is possible to find the force law, or to verify the correctness of a given form of interaction. In the quantum-mechanical description of the scattering process, the concept of the path of a particle becomes meaningless. Then a transparent potential may be defined as the potential which produces zero phase shift for all energies in a given angular-momentum state. Using the quantal formulation of the collision lifetime, it is shown that only for a class of transparent potentials the time delay is nonzero and therefore this class of interactions has an observable two-body effect. (auth)

19574 RADIAL JOST FUNCTIONS IN SCATTERING THEORY. Nesbet, R. K. (IBM Research Lab., San Jose, CA). J. Math. Phys. (N. Y.); 14: No. 11, 1522-1526(Nov 1973).

Several methods have recently been proposed for representing oscillatory wave functions by relatively slowly varying modulations of known oscillatory functions. Direct computation of the modulating function leads to efficient numerical or variational procedures and to accurate interpolation over energy or other parameters of a scattering problem. A new method, based on the phase integral (WKB) formalism, is proposed in a form applicable to multichannel scattering. The method generalizes the phase integral method to make use of arbitrary oscillatory comparison functions, rather than just plane waves as in the

usual formalism. It makes use of the modulating factor of the radial Jost function. Several examples of the proposed method are given, including an application to a two-channel model problem. (auth)

19575 DISCRETE VERSION OF THE MARCHENKO EQUATIONS IN THE INVERSE SCATTERING PROBLEM. Case, K. M.; Chiu, S. C. (Rockefeller Univ., New York). J. Math. Phys. (N. Y.); 14: No. 11, 1643-1647(Nov 1973).

For s-wave and one-dimensional scattering, the discrete Marchenko equations with respect to nontrivial comparison systems were derived. A relation with the Gel'fand–Levitan equation is obtained. The continuum versions are obtained by a limiting process. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

19576 STRUCTURE OF THE BOUND STATE SPECTRUM OF TWO ROTONS IN SUPERFLUID HELIUM. Pitaevskii, L. P.; Fomin, I. A. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2516-2521(Dec 1973). (In Russian).

The behavior of the branches of the superfluid helium spectrum corresponding to the bound states of two rotons is considered. An explicit expression is obtained for the dependence of the binding energy on the total momentum of the two rotons in the range of low momenta $p \ll \sqrt{\mu\epsilon}$. The asymptotic behavior of the branches in the high momentum range, $p_0 \gg p \gg \sqrt{\mu\epsilon}$, is found. The width of the bound state due to the possibility of decay into two phonons is estimated. (auth)

19577 THERMOMETRY USING THE OSMOTIC PRESSURE OF MIXTURES OF ^{3}He IN SUPERFLUID ^{4}He. Rosenbaum, R. L.; Eckstein, Y.; Landau, J. (Technion-Israel Inst. of Tech., Haifa). Cryogenics; 14: No. 1, 21-24(Jan 1974).

Recent measurements of the osmotic pressure of mixtures of ^{3}He in superfluid ^{4}He demonstrate the feasibility of temperature measurement using either of two experimental techniques. The first method measures the osmotic pressure of the saturated mixture and is useful for thermometry down to 30 mK. The second method, discussed in this paper, uses very dilute mixtures and is useful down to 10 mK. (auth)

19578 SPIN WAVES IN ANISOTROPIC SUPERFLUID ^{3}He. Maki, K. (Tohoku Univ., Sendai). Phys. Lett.; 46A: No. 3, 173-174(17 Dec 1973).

Spin waves in the A phase of the superfluid ^{3}He are studied within a microscopic model. It is shown that the spin wave mode with a phonon like dispersion and a gap exists throughout the A phase. (auth)

19579 EXCITATION SPECTRUM FOR INTERACTING BOSONS. Khanna, K. M.; Das, B. K. (Birla Inst. of Tech., Ranchi, India). Physica; 69: No. 2, 611-622(1 Nov 1973).

The energy excitation spectrum of a system of bosons interacting through a two-body potential composed of a hard core followed by a sum of two gaussians and having a density equal to that of liquid ^{4}He at the lambda transition temperature ($Q_\lambda = 2.06 \times 10^{22}$ particles/cm^3) is obtained using the reaction matrix formalism. The spectrum gives not only a qualitative agreement, showing the "phonon" branch and the "roton" dip clearly, but also a quantitative agreement when compared with the experimental energy excitation spectrum for liquid ^{4}He. The maximum and the minimum of the theoretical energy excitation spectrum occur at $k = 1.1$ Å^{-1}, $E_k/\chi = 13.56$ K, and at $k = 1.9$ Å^{-1}, $E_k/\chi = 8.692$ K, respectively. These values compare very favorably with the experimental values which are maximum at $k = 1.1$ Å^{-1}, $E_k/\chi = 13.7$ K, and minimum at $k = 1.91$ Å^{-1}, $E_k/\chi = 8.65$ K. To obtain good experimental agreement, the other parameters are $m^*/m = 1.2$ and the hard-core diameter $a = 2.1$ Å. (auth)

Superconductivity

Refer also to abstracts 12893, 18895, 19444, 20403, and 20541.

19580 (COO-1054-58) BOUNDARY CURRENT AND MODULATED FLUX MOTION IN SUPERCONDUCTING THIN Pb FILMS. Kim, Y. W.; de Graaf, A. M.; Chen, J. T.; Friedman, E. J. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Physics). 1972. 6p. (CONF-720833-31). Dep. NTIS $3.00.

From thirteenth international conference on low temperature physics; Boulder, Colorado, USA (20 Aug 1972).

If a constant homogeneous magnetic field, $\vec{H}$, is applied along the normal of a superconducting thin film carrying an rf current, $\vec{J}$, an oscillatory flux motion results in the direction perpendicular to both $\vec{H}$ and $\vec{J}$. Results were reported of an experiment designed to study the effects of an additional weak modulating magnetic field on the flux motion at microwave frequencies. It was found that the electric field, $\vec{E}$, associated with the flux motion driven by $\vec{J}$ can be amplitude-modulated. Here the salient features of this phenomenon at microwave frequencies are described briefly and the results of recent experiments examining its dependence on the frequency of the rf current are reported. (MHR)

19581 (JUL-994-FF) MAGNETIC FLUX LINE PINNING IN NbTa BY Nb_2N PRECIPITATION. Antesberger, G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. Fuer Festkoerperforschung). Aug 1973. 90p. (In German). Dep. NTIS (U.S. Sales Only) $6.50.

Thesis. Submitted to Univ., Innsbruck.

The pinning of magnetic flux lines in a system (NbTa + Nb_2 precipitations) whose superconducting properties and metallurgical structure have been known from x-ray measurements and investigations with the electron microscope is investigated. Based on this information and experimentally determined values for the volume pinning force P_v it has been possible to draw conclusions as to the interaction K_0 between a single flux line and a single precipitation of normal conductivity. (GE)

19582 RANGE OF VALIDITY OF THE CRITICAL-VELOCITY MODEL IN SUPERCONDUCTORS. Takacs, S. (Electrotechnical Inst., Bratislava). Czech. J. Phys.; 23: No. 10, 1057-1067(1973).

From the distribution function of normal electrons in the energy gap of the superconductor, the influence of the electric current on the density of superconducting electrons is calculated and the maximum lossless velocity v_c of the electrons is determined. The value of v_c limits also the range of validity of the critical-velocity model, calculated under the assumption of a rigidly pinned vortex lattice. The range of applicability of the critical-velocity model is shown to be restricted to the immediate vicinity of the upper critical field. (auth)

19583 PHONON LINE WIDTH IN SUPERCONDUCTORS. Schuster, H. G. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 46A: No. 3, 163-164(17 Dec 1973).

It is shown that a measurement of the phonon line width of strong coupling superconductors by inelastic neutron scattering can be used to detect parallel parts in the Fermi surface of the metal. Recent measurements for Nb_3Sn are analyzed. (auth)

19584 INFLUENCE OF PRESSURE AND PARAMAGNETIC IMPURITIES ON PROPERTIES OF SUPERCONDUCTORS. Palistrant, M. E.; Trifan, A. T. (Inst. of Applied Physics, Kishinev, USSR). Phys. Lett.; 46A: No. 3, 165-166(17 Dec 1973).

An investigation is made of the influence of a Fermi-surface topology change under pressure and paramagnetic impurities on the superconducting transition temperature, on the order parameter and on the energy gap at zero temperature. The critical impurity concentrations are not the universal values and depend on the valence difference between the impurity atoms and the metal atoms. (auth)

19585 SUPERCONDUCTIVE TUNNELING INTO $Nb_3(Al_{0.75}Ge_{0.25})$. Gregory, J. A.; Bostock, J.; MacVicar, M. L. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett.; 46A: No. 3, 201-202(17 Dec 1973).

Current and conductance characteristics have been obtained for $Nb_3(Al_{0.75}Ge_{0.25})$ barrier $Pb_{0.7}Bi_{0.3}$ superconducting tunneling junctions prepared on $Nb_3(Al_{0.75}Ge_{0.25})$ ribbon substrates. Thermal oxide, anodized, and amorphous carbon tunneling barriers were used. These junctions are relatively fragile: they deteriorate under temperature recycling or sustained bias. Typical junction resistances are of the order of 50Ω, and $2\Delta(0)$ of $Nb_3(Al_{0.75}Ge_{0.25})$ is ~1.3 MeV. (auth)

19586 THEORY OF SUPERCONDUCTIVITY IN SYSTEMS WITH AN INVERSE DISTRIBUTION. Elesin, V. F.; Kopaev, Yu. V.; Timerov, R. Kh. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2343-2355(Dec 1973). (In Russian).

The interband recombination time in a semiconductor may exceed the intraband relaxation time and hence an inverse electron distribution in the conductivity band may be produced by means of an external source. If the semiconductor gap E_g does not exceed a certain critical value a superconducting state arises on repulsion between the electrons. For a single-band metal with electron repulsion, besides the trivial solution with a zero superconducting gap, there exists a stationary nontrivial solution with an inverse distribution providing the superconducting gap exceeds the limiting phonon energy. It is shown that in such systems an undamped current exists which corresponds to ideal paramagnetism. The Meissner effect therefore is absent in such superconductors and a magnetic field penetrates the sample and experiences spatial oscillations. Models of a semi-metal and of a two-band metal with overlapping bands with different masses are also considered. (auth)

19587 RELATION BETWEEN SUPERCONDUCTING PROPERTIES AND THE STRUCTURE OF AMORPHIC LOW TEMPERATURE BISMUTH FILMS. Belevtsev, B. I.; Komnik, Yu. F.; Yatsuk, L. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2455-2465(Dec 1973). (In Russian).

The effect of heating (annealing) at various temperatures on the critical temperature T_c for the superconducting transition in "amorphic" bismuth films obtained by condensation of molecular beams on backings at helium temperatures is studied in the region of existence of the "amorphic" phase. Along with decrease of the specific resistance ρ a drop of T_c is also observed. Low-temperature electron diffraction investigations show that the coordinational structure of "amorphic" bismuth films changes upon heating (in the direction of disordering); it also varies with time when the condensation temperature is maintained. In the latter case the reorganization of the structure is accompanied by a weak growth of the resistance and T_c. Calculations relating the variation of ρ and T_c with variation of the coordinational structure are carried out. Data on the structure factor and the radial distribution function of the electron density are employed in the calculations. In order to determine the behavior of T_c the dispersion curves of quasiphonon excitations are calculated and the electron–phonon coupling constant λ is determined. (auth)

19588 EFFICIENCY OF THE EXCITONIC MECHANISM OF SUPERCONDUCTIVITY IN FILMS. Uspenskii, Yu. A.; Zharkov, G. F. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2511-2515(Dec 1973). (In Russian).

The effect of excitonic excitations localized in the semiconducting coating on the critical temperature of superconducting films is considered. Numerical estimates of the contribution of such excitations to the electron pairing interaction constant are presented for coatings with various dependences of the dielectric permeability $\epsilon(\omega, q)$. (auth)

19589 EFFECT OF LASER RADIATION ON SUPERCONDUCTIVITY. Vardanyan, R. A.; Ivlev, B. I. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2315-2326 (Dec 1973). (In Russian).

The properties of the nonequilibrium state created in a superconducting sample by laser radiation is considered. The dependence of the gap in the superconductor spectrum on temperature, irradiance and coordinates is obtained. The results are in agreement with available experimental data. The behavior of a superconductor in a varying field with a frequency close to that corresponding to the gap width is investigated. (auth)

19590 LOW TEMPERATURE ENHANCEMENT OF THE CRITICAL FIELD FOR A Nb_3Sn SUPERCONDUCTING MAGNET. Hollis, R. L.; Ryan, J. F.; O'Sullivan, W. J. (Univ. of Colorado, Boulder). Cryogenics; 14: No. 1, 8-9(Jan 1974).

The maximum quenching field for a Nb_3Sn superconducting magnet was increased from 137 kG to above 150 kG by cooling the magnet from 4.2 K to 1.9 K. A method of magnetic field calibration was employed using the Raman spin-flip signal in ZnSe : In. (auth)

19591 VELOCITY DISTRIBUTION FROM FLUX FLOW SIMULATION EXPERIMENTS. Meissner, H. (Stevens Inst. of Tech., Hoboken, NJ). Cryogenics; 14: No. 1, 36-41(Jan 1974).

Magnet needles floating in a cupric sulphate solution through which a strong current is passed are used to simulate flux flow in superconducting thin films. Pinning barriers are provided at regular intervals by cross-magnetized strips. The applicability of the model is limited by the presence of a dissipative term proportional to the square of the velocity and by a mass term. Single needles show the expected roughly sinusoidal velocity dependence on distance. Lattice type arrays of needles lose this behavior already at low densities. The pinning current decreases drastically as the density of the needles is increased. (auth)

19592 SUPERCONDUCTIVITY AT HIGH PRESSURE. Gey, W. (Kernforschungszentrum, Karlsruhe, Ger.). Umsch. Wiss. Tech.; 73: No. 21, 668-669(Nov 1973). (In German).

High pressure is used as a tool to investigate the parameters that determine the superconducting transition temperature. A better understanding of this quantity may result in the development of technologically interesting superconductors. (GE)

Equipment and Devices

19593 (CEA-CONF-2300) LEAK-TIGHTNESS PROBLEMS IN SEPARABLE JOINTS USED AT LOW-TEMPERATURES. Claudet, G.; Verdier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Mar 1972. 17p. (In French). (CONF-720574-3). Dep. NTIS (U.S. Sales Only) $3.00.

From spring meeting of the mechanical engineering development group; Paris, France (16 May 1972).

The leak-tightness in joints used at low-temperature is important to be taken in account because the cold parts of cryogenic devices are usually insulated by high vacuum. The problems of leak tightness are in connection with the modification of physical properties of materials by cooling, even mechanical properties (elasticity, ductility, resilience) or thermal properties (expansion, specific heat, conductivity), the latter being of particular importance in transient working conditions. Some examples of solutions given in significant realization are described. (auth)

19594 (JUL-956-TP) CRYOGENICS FOR POWER SUPPLY WITH SUPER-CONDUCTING MAGNETS. Komarek, P. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. Fuer Technische Physik). Jun 1973. 329p. (In German). Dep. NTIS (U.S. Sales Only) $18.50.

Thesis.

The possible contribution to be expected from the field of cryogenics to solving the problem of meeting our energy demands in the near and far future is discussed. Superconducting magnets are of great importance in this respect as they will be needed for the energy conversion with MHD-generators and in fusion reactors, for electrical machines and in superconducting inductive energy storage devices. The present work discusses the problems associated with these superconducting magnets as integrated components of the various power generating or transmitting facilities. (GE)

19595 (ORNL-TM-4456) DIAMAGNETIC EFFECTS IN A TAPE-WOUND SUPERCONDUCTING SOLENOID. Walstrom, P. L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 12p. Dep. NTIS $3.00.

The effect of diamagnetic shielding currents on the magnetic field in a tape-wound superconducting solenoid is calculated on the basis of the isothermal critical state model and compared with measured values. The calculation is found to be in reasonable agreement with the data. Additional calculations showing the effect of the tape width on the diamagnetic correction to the central field are presented. (auth)

19596 (UCRL-74964) PROGRESS ON ALUMINUM-CLAD Nb_3Sn. Henning, C. D.; Nelson, R. L.; Ward, C. O.; Rowe, C. L.; Moon, D. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Aug 1973. 30p. (CONF-731114-3). Dep. NTIS $3.50.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Development of aluminum-clad Nb_3Sn has continued in the pursuit of higher magnetic fields for controlled thermonuclear research. While earlier experiments confirmed the necessity of conservative cryogenic stability of such conductors, the resulting current densities from recent experiments remain quite acceptable for large applications. Cryogenic stability also provides the high reliability often required. Accordingly, more advanced superconductors have been tested with extensive cooling channels between the magnet turns, and temperature differences have been minimized through the aluminum bonds and structural materials. In addition, liquid helium has been circulated through the magnet to prevent vapor-locking during massive flux jumps. (auth)

19597 AC LOSSES AT 4.2 K IN HEAT-TREATED NIOBIUM WIRE. Salmon, D. R.; Catterall, J. A. (National Physical Lab., Teddington, Eng.). J. Phys., D (London); 6: No. 17, 2111-2114 (15 Nov 1973).

Samples of heavily worked, cold-drawn niobium wire were heat-treated at temperatures between 200 and 700°C to produce changes in the magnetization behavior of the material. An investigation was then carried out to determine the influence of these changes on the AC power losses produced in the wires at 4.2 K due to 50 Hz transport currents of up to 120 A. The results show that the power losses at a particular current increase as the field of initial penetration into the niobium, H_p, decreases. (auth)

19598 INTERACTION OF HIGH-CURRENT SINGLE BUNCH WITH ACCELERATING RESONATOR. Serov, V. L.; Bar'ishev, A. I. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 6, 406-412(1972). (In Russian).

Some effects of interactions of single bunch with large number of particles with cylindrical superconducting resonator are considered. It is shown that there is a limited number of particles depending on the wavelength of accelerating tension, energy accumulated in resonator and on the length of the bunch. The excitation of resonator by the bunch of particles leads to large energy spread of particles inside the bunch which is necessary to account in radial-phase motion in cyclic accelerator. At multiple passing of the bunch through the resonator the undesirable effect connected with the radiation at high modes can be reduced if the resonances between natural oscillation frequencies and the bunch passing frequency are excluded. Corresponding formulae and also the results of numerical calculations are given. (auth)

19599 SUPERSWITCH FOR TOMORROW'S COMPUTER.
Matisoo, J. (IBM Watson Research Center, Yorktown Heights, NY). New Sci.; 61: No. 880, 71-74(10 Jan 1974).

The Josephson tunneling cryotron combines the concepts of superconductivity and electron tunneling and by virtue of its extremely short switching time and low power consumption, shows considerable potential as a universal computer building block. It promises to replace the transistorized circuits of a computer's central processor and also provides a very fast memory cell. Devices capable of switching thousands of times faster than anything else have already been tested. Now the fabrication technology is being perfected. (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 18780, 19696, 19788, 19814, and 20255.

19600 (AWRE-O-42-73) FORTRAN IV VERSION OF THE AWRE ONE-DIMENSIONAL MULTIGROUP NEUTRON TRANSPORT S_n PROGRAM STRAINT. Dugan, K.; Price, J. A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Dec 1973. 96p. Dep. NTIS (U. S. Sales Only) $7.00. UK £2.

The one-dimensional multigroup neutron transport S_n program STRAINT was originally written in S_2 FORTRAN (a dialect of FORTRAN 2) by R D Wade (AWRE Report 012/63 (1963)) for the IBM 7030. It has recently been translated into FORTRAN IV for use on the IBM 360 and 370 machines. This report describes in detail the FORTRAN IV version of the program, its capabilities and operating instructions. (auth)

19601 (RT/FI-(73)39) AMARA: A CODE USING THE LAGRANGE'S MULTIPLIERS METHOD FOR NUCLEAR DATA ADJUSTMENT. Gandini, A.; Petilli, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 23 Oct 1973. 60p. Dep. NTIS (U.S. Sales Only) $5.00.

The optimization of nuclear data is here treated by using the method of Lagrange multipliers for the solution. This method seems to gain in calculation time and computer memory, with respect to other methods used, as the code AMARA shows. However, no differences in the values of the solution are observed. (auth)

19602 (UJV-3096-R) SOLUTION OF ENERGY-DEPENDENT BOLTZMANN EQUATION IN A SYSTEM OF SLABS. Kyncl, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Sep 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

The question of half-range completeness for the set of particular solutions to the energy-dependent linear Boltzmann equation is discussed. Arbitrary medium is taken into account, and the problem of finding of directional neutron flux in the system of infinite homogeneous slabs is solved in general. As an example, the case of kernels proposed by Corngold is considered in more detail. (auth)

19603 NEUTRON THERMALIZATION AS A FLUCTUATION OF THE NONEQUILIBRIUM STEADY STATE. Hayasaka, H. (Tohoku Univ., Sendai). Jap. J. Appl. Phys.; 12: No. 10, 1611-1620(Oct 1973).

The neutron thermalization problem has been reconsidered as a fluctuation of a steady state in an absorbing medium. If energy dependent neutron density distributions are chosen as random variables, the thermalization process can be treated as a Markoffian random process in which an incompletely thermalized neutron field approaches the steady state. It is shown that the thermalization matrix corresponds to the first moment-drift vector-, and that the diffusion constant is represented by a generalized Einstein relation. Since the loss of energy of the neutron per collision with a heavy moderator nucleus is very small in the thermalization process, the Smoluchowski integral equation is converted into the Fokker–Planck equation. The quasi-Onsager reciprocal relation is obtained with respect to the steady state of the neutron thermalization process, in which neutrons are supplied, scattered and captured. (auth)

19604 NEUTRON SPIN PRECESSION IN POLARIZED NUCLEAR TARGETS. Forte, M. (EURATOM CCR, Ispra, Italy). Nuovo Cim.; 18A: No. 4, 726-736(21 Dec 1973).

When a neutron beam is transmitted by a polarized nuclear target, the spin-dependent part of the neutron optical potential causes a neutron spin precession. The connection of this potential with the nuclear scattering amplitudes is reviewed with regard to the approximations involved in current formulations. The neutron spin precession modified by a spin dependence of the neutron wave attenuation is analytically described. The principles and preliminary results are presented of new experiments which measure directly a neutron spin rotation, proportional to the real spin-dependent part of the scattering amplitude. Such experiments are very sensitive at low neutron energy. (auth)

19605 EXAMINATION OF THERMAL NEUTRON SCATTERING MODELS FOR LIGHT AND HEAVY WATER BY COMPARISON WITH DIFFUSION AND CROSS-SECTION DATA. Butland, A. T. D. (United Kingdom Atomic Energy Authority, Winfrith, Eng.); Chudley, C. T. J. Brit. Nucl. Energy Soc.; 13: No. 1, 99-114(Jan 1974).

The provision of simple models for the scattering of neutrons by light and heavy water for use in reactor calculations is considered. The main criterion used for the models is that they should be in good agreement with measurements of the neutron diffusion coefficient, and an extensive review is given of experimental diffusion data for both light and heavy water. Various simple models are presented and compared with experimental measurements of diffusion parameters, total cross-section and, for light water only, the mean kinetic energy of the hydrogen atom. (auth)

19606 ANALYSIS OF INELASTIC NEUTRON SCATTERING BY LIQUID METHANE. Chung, C. H. (Seoul National Univ.); Shin, W. K.; Kim, J. S. J. Korean Nucl. Soc.; 5: No. 4, 265-278 (Dec 1973).

The incoherent neutron scattering cross section of molecular liquids is analyzed using a damping function model for correlation functions of molecular translations and rotations. The present approach is different from recent works in that the scattering function is evaluated directly, not through the intermediate scattering function. The damping function is determined from a simple relation between its long-wavelength limit and the generalized frequency distribution function, and translation-rotation couplings are assumed to be neglected. A physical model is used for the translational motions of center-of-mass of a molecule, including properly its short-time and long-time behaviors. A simple model for the rotational motions is suggested which relates the damping function to the Fourier transform of the dipole correlation function, or equivalently, the infrared vibrational absorption spectrum. Theoretical absolute scattering intensities are computed for liquid methane and shown to be in satisfactory agreement with both thermal and cold neutron measurements. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 19361, 19391, 19624, and 19696.

19607 (NP-19939, p 147) GENERATOR CO-ORDINATE METHOD FOR ^{4}He. Pal, M. K. 1971.

19608 RESONANT STRUCTURE OBSERVED IN THE ^{3}He $(\tau,\gamma)^6$Be CAPTURE REACTION. Ventura, E.; Calarco, J.; Chang, C. C.; Diener, E. M.; Kuhlmann, E.; Meyerhof, W. E. (Stanford Univ., CA). Nucl. Phys.; A219: No. 1, 157-170(1974).

The ^{3}He$(\tau,\gamma)^6$Be capture reaction was studied for ^{3}He bombarding energies from 12 to 27 MeV. Transitions to the first excited state in ^{6}Be(T = 1, 2^+) are readily seen. Transitions to the ground state in ^{6}Be(T = 1, 0^+) are very weak and their presence could not be ascertained. The 90° excitation function for these transitions shows a broad maximum centered at E_τ = 23 ± 1 MeV. This is interpreted as a resonance in the compound nucleus ^{6}Be at E_x = 23.0 ± 0.5 MeV with a configuration other than ^{3}He + ^{3}He. These results are compared with other experimental work as well as with theoretical predictions. (auth)

19609 ^{20}Ne(^{3}He,n)^{22}Mg AT ^{3}He ENERGIES BETWEEN 2.6 AND 4.0 MeV. Bose, S. K.; Kogan, A.; Bevington, P. R. (Case Western Reserve Univ., Cleveland). Nucl. Phys.; A219: No. 1, 115-124 (1974).

The ^{20}Ne(^{3}He,n) reaction leading to the ground state of ^{22}Mg was investigated in the ^{3}He$^+$ energy range of 2.6 to 4.0 MeV. Angular distributions were determined with a neutron time-of-flight spectrometer at average incident energies (lab) of 3.27, 3.69, and 4.01 MeV between 0° and 120° (lab). Excitation functions for the energy region were measured at 0° and 80° (lab). The observed differential cross sections are explained by coherent contributions from direct interaction and compound-nucleus formation. A spectroscopic factor was extracted for the DWBA calculation from the absolute cross-section measurements and found to be S = 0.43 ± 0.21. Resonances in the compound-nucleus formation were found at 3.00 and 3.33 MeV (c.m.) with widths of 0.28 and 0.21 MeV and spins of $\frac{1}{2}^+$ and $\frac{1}{2}^-$, respectively. (auth)

19610 MESON-EXCHANGE CORRECTIONS TO THE CROSS SECTION FOR $n + H^2 \rightarrow H^3 + \gamma$. Hadjimichael, E. (Univ. of Sussex, Brighton, Eng.). Phys. Rev. Lett.; 31: No. 3, 183-187 (16 Jul 1973).

It is shown that agreement between theory and experiment regarding the cross section for radiative neutron–deuteron capture can be achieved by considering the effects of meson-exchange current on the magnetization density of the three-body system. The calculated cross section is 0.52 ± 0.05 mb. (auth)

19611 DISPERSION RELATIONS FOR ELASTIC n–d SCATTERING IN THE AMADO MODEL. Stelbovics, A. T.; Dodd, L. R. (Univ. of Adelaide). Phys. Lett.; 48B: No. 1, 13-16(7 Jan 1974).

The formulation of rigorous, dispersion relations for on-shell three-body amplitudes in a separable model is reported. The results of approximate N/D calculations of s-wave n-d elastic scattering are compared with exact, numerical solutions of the Faddeev equations. (auth)

19612 INVESTIGATION OF THE SYNTHESIS REACTION $d\mu + d \rightarrow {}^3He + n + \mu$ IN GASEOUS DEUTERIUM. Bystritskii, V. M.; Dzhelepov, V. P.; Oganesyan, K. O.; Omel'yanenko, M. N.; Porokhovoi, S. Yu.; Rudenko, A. I.; Fil'chenkov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 1, 61-67(Jan 1974). (In Russian).

The yield and time distribution of neutrons from the synthesis reaction in the $dd\mu$ mesomolecule are measured with a gaseous target containing ultrapure 41 atmosphere deuterium (content of impurities with $Z > 1$ is $\lesssim 10^{-5}$). The experiments are performed with the muon beam of the Dubna synchrocyclotron. The rate $\lambda_{dd\mu}$ of $dd\mu$ molecule formation in gaseous deuterium at T = 300°K and the rate λ_f of the nuclear reaction in this mesomolecule are derived by analyzing the time distribution (918 events). The value obtained $\lambda_{dd\mu} = (0.73 \pm 0.07) \cdot 10^6$ sec^{-1} and previous data for T = 240°K (obtained in experiments with a diffusion chamber) confirm the theoretically predicted existence of a mechanism of $dd\mu$ molecule formation which is in resonance with the $d\mu$ atom energy. Direct data on the magnitude of λ_f are obtained for the first time. The experimental value $\lambda_f > 1.8 \cdot 10^6$ sec^{-1} (with a probability of 90%) is in agreement with the theoretical results. (auth)

19613 STUDY OF THE REACTION $^3He(e,pd)e'$ BY THE COINCIDENCE METHOD AND NEW RESULTS ON THE $^2He(e,p)ne'$ REACTION. Shin, Y. M.; Skopik, D. M.; Tomusyak, E. L. (Univ. of Saskatchewan, Saskatoon). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1863-1869(Sep 1973). (In Russian).

Measurement of the cross section of the $^3He(e,pd)e'$ reaction by the coincidence method did not indicate an excited state near the photon point. The dependence of the reaction cross section on the momentum transfer at fixed energy indicated sufficient sensitivity in the approximation used to the form of the wave function of the ground state. In the $^2He(e,p)ne'$ reaction the deuteron spallation reaction by electrons can not be explained by the virtual proton theory. (7 figures) (JSR)

19614 ASYMMETRY IN THE REACTION $\alpha + d \rightarrow t + {}^3He$ AT 55 MeV (c.m.) AND BARSHAY–TEMMER THEOREM. Bachelier, D.; Bernas, M.; Boyard, J. L.; Hennino, T.; Jourdain, J. C.; Radvanyi, P.; Roy-Stephan, M. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A219: No. 3, 573-588(1974).

The complete angular distribution and the forward-backward asymmetry were measured for the reaction $\alpha + d \rightarrow t + {}^3He$ at 55 MeV (c.m.). Validity of the isospin concept requires this angular distribution to show up a forward-backward symmetry, following a theorem by Barshay and Temmer. Important asymmetries have been observed previously at lower energies. At 55 MeV a small but significant angle dependent asymmetry appears, which is, however, only about half the one observed at 27 MeV (c.m.). A calculation of the Coulomb effects in a DWBA analysis seems to account for this asymmetry. Other possible effects are also discussed. (auth)

19615 TRIPLE SELF CONSISTENT SOLUTION OF THE THREE-PARTICLE BETHE–FADDEEV AND BRUECKNER–HARTREE–FOCK EQUATIONS. Zabolitzky, J. G. (Ruhr Univ., Bochum, Ger.). Phys. Lett.; 47B: No. 6, 487-490(24 Dec 1973).

Completely self consistent Brueckner–Hartree–Fock (BHF) calculations with inclusion of the three-particle Bethe–Faddeev (BF) amplitudes were performed on ^4He and ^{16}O both for the Reid-soft-core (RSC) and Tourreil–Sprung super-soft-core (SSC) potential. Binding energies and root mean square radii come out better than with parameter free BHF-type calculations. The name FBHF (3) (Faddeev–Brueckner–Hartree–Fock) is coined for this type of calculation. (auth)

19616 DISINTEGRATION OF THE DEUTERON BY 4 TO 11 MeV ELECTRONS. Phenneger, M. C.; Winter, R. G. (Coll. of William and Mary, Williamsburg, VA). Nucl. Phys.; A219: No. 3, 589-594(1974).

The ratio of photodisintegration to electrodisintegration yields was measured in the 4 to 11 MeV region. The results are in good agreement with a virtual photon calculation. (auth)

19617 NEGATIVE PARITY SPECTRUM OF ^4He CALCULATED WITH THE SUSSEX INTERACTION. Singh, B. (American Univ., Beirut, Lebanon). Nucl. Phys.; A220: No. 1, 198-204(1974).

The negative parity spectrum of ^4He was calculated by including all oscillator states at $3\hbar\omega$. The energies are found by employing second order perturbation theory and also by diagonalizing the matrices of the Hamiltonian in the $1 + 3\hbar\omega$ space. Sussex matrix elements are used. (auth)

19618 DIRECT SOLUTION OF THE HILL–WHEELER EQUATIONS FOR SCATTERING STATES IN THE PRESENCE OF COULOMB FORCES. Friedrich, H.; Huesken, H.; Weiguny, A. (Univ., Muenster, Ger.). Nucl. Phys.; A220: No. 1, 125-136(1974).

A method is presented for constructing Hill–Wheeler weight functions which, outside the nuclear interaction region, reproduce as physical wave functions the regular and irregular Coulomb functions. As an application, α–α phase shifts are calculated by de Takacsy's method of directly solving the Hill–Wheeler equations, with the Coulomb interaction included. The validity of de Takacsy's method in this case is established. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 18425, 19433, 19489, 19615, 19650, 19662, 19684, 19692, 19705, 19739, and 19837.

19619 (COO-1779-128, pp 10-12) REALISTIC TWO-BODY MATRIX ELEMENTS FOR THE (SD) SHELL. Maripuu, S.; Harris, G. I. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19620 (COO-1779-128, p 18) STUDY OF GIANT RESONANCES BY INELASTIC SCATTERING. Moalem, A.; Benenson, W.; Crawley, G. M. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19621 (COO-1779-128, p 30) SINGLE NEUTRON PICKUP ON ^{14}C. Maripuu, S.; Crawley, G. M.; deMeijer, R. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19622 (ZFK-212) INVESTIGATION OF THE REACTIONS $^{16}O(d,p)^{17}O$ and $^{16}O(d,\alpha)^{14}N$ FOR BOMBARDING ENERGIES E_d = 0.9 TO 2.0 MeV. Grambole, D.; Baldeweg, F.; Beckert, K.; Klabes, R.; Schneidereit, C. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jun 1971. 34p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

Angular distributions and excitation functions of the reactions $^{16}O(d,p)^{17}O$ and $^{16}O(d,\alpha)^{14}N$ for bombarding energies E_d = 0.9 to 2.0 MeV were measured. The differential cross sections of the angular distributions were analyzed in terms of Legendre polynomials. Tables of the experimental cross sections and the coefficients of the Legendre polynomial fits are given. (auth)

19623 PARAMETERS CHARACTERIZING THE DISTRIBUTION OF TRANSITION DENSITIES IN NUCLEI. Gul'karov, I. S. (Tashkent Polytechnical Inst.). Dokl. Akad. Nauk Uzb. SSR; No. 1, 27-28 (1973). (In Russian).

The parameters characterizing the distribution of transition densities were determined for the 4.43 (2^+) and 9.64 (3^-) MeV levels of ^{12}C. These parameters were obtained by analysis of previously obtained experimental data. The measured form factors of these levels were compared with those calculated within the framework of the Khelm phenomenological model and the modified Tass model. The analysis showed that the best agreement of theory with experiments is achieved if the parameters characterizing the distribution are changed 8 to 13%. (JSR)

19624 INVESTIGATION OF STATES IN ^{17}F BY THE $^{15}N(^3He,n)^{17}F$ REACTION. Etten, M. P.; Thornton, S. T. (Univ. of Virginia, Charlottesville). Z. Phys.; 264: No. 3, 187-200(1973).

The absolute differential cross sections for several levels in the $^{15}N(^3He,n)^{17}F$ reaction were measured at laboratory scattering angles from 0 to 140° using neutron time-of-flight techniques. Angular distributions were obtained at effective helium bombarding energies of 3.8 and 4.8 MeV. A new state was identified at 5.18 ± 0.02 MeV excitation energy which is probably the analog of the 5.217 MeV state in ^{17}O. Spectroscopic factors were obtained for the low-lying states using distorted wave method calculations. (GE)

19625 TOTAL CROSS SECTION OF $^{16}O(p,\alpha)^{13}N$ FROM THRESHOLD TO 7.7 MeV. McCamis, R. H.; Moss, G. A.; Cameron, J. M. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 16, 1689-1692(15 Aug 1973).

The reaction $^{16}O(p,\alpha)^{13}N$ plays an important part in explosive oxygen burning in stars, and the magnitude of its cross section is important in various astrophysical models of stellar evolution. Therefore, the cross section for this reaction was measured from

threshold to 7.7 MeV, which includes the range of astrophysical importance. The experiment was performed using an activation procedure, which is described. At the highest energies obtained, the cross section was compared to, and agrees very well with, earlier measurements. The reaction rate for this reaction was calculated, and was found to be much lower than the previous estimate for it. (auth)

19626 STANDARD METHODS FOR ESTIMATING THE THERMAL NEUTRON ABSORPTION CROSS SECTION OF NUCLEAR GRAPHITE. 1973 Annual Book of ASTM Standards. Part 13. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-C-626-71).

Three methods of estimating the thermal (2200 m/s) neutron absorption cross section of nuclear graphite are given. These methods apply to graphites to be used for moderator or reflector components of nuclear reactors and sub-critical test reactors and for thermal columns. Excluded from these methods are graphites containing fissionable materials for use as fuel or driver elements and graphites containing materials having high neutron absorption cross sections for use as reactor control or safety devices. The methods considered are those of boron and ash, common impurities, and DIH purity. (1 table) (RWR)

19627 NUCLEAR CHARGE RADII FROM X-RAY TRANSITIONS IN MUONIC ATOMS OF CARBON, NITROGEN, AND OXYGEN. Dubler, T. (Univ., Fribourg, Switzerland); Schellenberg, L.; Schneuwly, H.; Engfer, R.; Vuilleumier, J. L.; Walter, H. K.; Zehnder, A.; Fricke, B. Nucl. Phys.; A219: No. 1, 29-38(1974).

Energies of muonic x-rays of the K-series of carbon, nitrogen and oxygen were measured with an accuracy of about 15 eV. Root mean square radii of the nuclear charge distributions were deduced. The results 2.49 ± 0.05 fm for carbon, 2.55 ± 0.03 fm for nitrogen and 2.71 ± 0.02 fm for oxygen are in good agreement at comparable accuracy with recent electron scattering data. (auth)

19628 CHARGE EXCHANGE (^{6}Li,^{6}He) AND THE TWO-STEP PICKUP-STRIPPING (^{6}Li,^{7}Li)(^{7}Li,^{6}He) EXCITATION MODE. Duhm, H. H.; Hafner, H.; Renfordt, R.; Goldschmidt, M.; Dragun, O.; Kubo, K. I. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett.; 48B: No. 1, 1-5(7 Jan 1974).

The single-step forbidden analog $0^+ \rightarrow 0^+$ transition has been observed in (^{6}Li,^{6}He) on ^{28}O and ^{28}Mg. The cross section and the observed L = 1 shape of the angular distribution for the ^{28}Mg $\rightarrow$ ^{28}Al$_{0+,T=1}$ transition is analyzed in terms of a single-nucleon pickup-stripping two-step process in the second order DWBA. There are indications that the single step allowed (^{6}Li,^{6}He) charge exchange transitions contain large two step contributions as well. (auth)

19629 SECOND ORDER BINDING ENERGIES AND SPECTRA WITH AN INTERACTION MATRIX DEDUCED FROM PHASE SHIFTS. Sanderson, E. A.; Elliott, J. P.; Mavromatis, H. A.; Singh, B. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys.; A219: No. 1, 190-220(1974).

The matrix elements deduced from phase shifts in an earlier paper are modified to incorporate the effects of a hard core and then used in second order perturbation theory to calculate binding energies and spectra for some light nuclei near closed shells. (auth)

19630 PHOTODISINTEGRATION OF THE ^{12}C NUCLEUS FOR A MAXIMAL BREMSSTRAHLUNG ENERGY OF 345 MeV. Bochek, G. L.; Grishaev, I. A.; Etets, N. L.; Lapin, N. I.; Pugachov, G. D.; Ranyuk, Yu. N. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 1, 16-22(Jan 1974). (In Russian).

The energy spectra of charged pions and protons are measured at angles of 30, 60, 90, 120 and 150° in the laboratory system for a maximal bremsstrahlung energy of 345 MeV. Charged pions with kinetic energies from 10 to 100 MeV and protons with energies from 30 to 160 MeV emitted from the ^{12}C nucleus are recorded by the photographic emulsion technique. The differential cross sections for photoproduction of protons are in agreement with the cascade model calculations; the agreement is less satisfactory for pions. (auth)

19631 EFFECT OF CORE-EXCITATIONS AND SU$_4$-SYMMETRY BREAKING UPON THE MUON CAPTURE RATE IN ^{16}O. Saarela, M.; Erkkilae, P.; Kallio, A. (Oulu Univ., Finland). Phys. Fenn.; 8: No. 1, 51-65(May 1973).

The total muon capture rate in ^{16}O is calculated with an improved ground-state wave function containing a deformed component. The results are given in the closure approximation and with the method of explicit summation over intermediate states. In the second case a rate only 30% greater than the experimental value is obtained. In all cases the SU$_4$-symmetry breaking is found to be less than 6%. (auth)

19632 IMPORTANCE OF THE THREE-BODY EFFECTIVE FORCE IN THE SPECTRA OF SOME Op SHELL NUCLEI. Singh, B. (American Univ. of Beirut). Nucl. Phys.; A219: No. 3, 621-628(1974).

An attempt was made to ascertain the importance of the three-body effective force in the normal parity spectra of nuclei with A = 7, 13, and 14 by calculating their spectra with and without the three-body diagram. It is found that for the heavier nuclei, neglect of this part of the effective force is not justified. The calculations were done with the Sussex interaction. (auth)

19633 HELM-MODEL AND SHELL-MODEL STUDIES OF THE PHOTOPRODUCTION OF CHARGED PIONS IN ^{12}C. Seaborn, J. B.; Davanathan, V.; Ueberal, H. (Catholic Univ. of America, Washington, DC). Nucl. Phys.; A219: No. 3, 461-474(1974).

Differential and total cross sections for the reactions ^{12}C(γ,π^-)-^{12}N and ^{12}C(γ,π^+)^{12}B are calculated on the generalized Helm model and the shell model. The Chew-Low reaction amplitude and the Born approximation are used in the calculation. The shell-model cross sections are generally four to eight times larger than the Helm-model prediction. This is consistent with results obtained for other processes where the shell model overestimates the experimentally observed quantities. (auth)

19634 (d,p) REACTION TO BOUND AND UNBOUND STATES OF ^{19}O. Sen, S.; Darden, S. E.; Hiddleston, H. R.; Yoh, W. A. (Univ. of Notre Dame, IN). Nucl. Phys.; A219: No. 3, 429-449 (1974).

Cross section and vector analyzing power were measured for the (d,p) reaction on ^{18}O leading to neutron bound and unbound states in ^{19}O at an incident deuteron energy of 14.8 MeV. The bound state data are compared to DWBA predictions. The data for the unbound states were analyzed in the framework of the DWBA using a form factor for a weakly bound neutron and a resonance form factor, following the approach of Vincent and Fortune. The spin-parity assignments and spectroscopic factors or widths for most of the observed states with excitation energy up to 6.28 MeV were extracted. The spectroscopic factors are in fair agreement with those obtained from recent shell model calculations. Wherever comparison is meaningful, the extracted widths agree reasonably well with the values obtained from neutron scattering experiments. The primary constituent of the broad maximum which appears in the proton spectrum at ≈ 5.5 MeV excitation is found to be a $D_{\frac{5}{2}}$ state. The presence or absence of more than one group in this energy region cannot be concluded from the present data. (auth)

19635 PHOTODISINTEGRATION OF ^{13}C. Kissener, H. R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Aswad, A.; Eramzhian, R. A.; Jaeger, H. U. Nucl. Phys.; A219: No. 3, 601-611(1974).

The nucleon decay of the photoresonance in ^{13}C is analyzed using bound-state shell model and R-matrix theory. Total and partial photo cross sections, branching ratios, final state population, and nucleon emission spectra are considered and compared with available data. (auth)

19636 INVESTIGATION OF THE HIGHLY EXCITED STATES OF ^{9}Be AND ^{10}Be IN ^{7}Li(d,p)^{8}Li, ^{6}Li(t,p)^{8}Li, AND ^{7}Li(t,p)^{9}Li REACTIONS. Abramovich, S. N.; Guzhovskii, B. Ya.; Zvenigorodskii, A. G.; Trusillo, S. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1967-1970(Sep 1973). (In Russian).

The excitation functions of the ^{7}Li(d,p)^{8}Li, ^{6}Li(t,p)^{8}Li, and ^{7}Li(t,p)^{9}Li reactions were measured. The existence of the 18.52- and 19.2-MeV levels of ^{9}Be was confirmed, and states at 20.43 and 20.74 MeV were observed. On the basis of the assumptions on the nature of the observed characteristics of the excitation function for the ^{7}Li(t,p)^{9}Li reaction, the energy of the state of ^{10}Be with T = 2 (E_x = 21.185 MeV) was given and an evaluation was made of the neutron binding energy in ^{10}Li as $\epsilon_n = -62 \pm 60$ keV. (2 figures) (tr-auth)

19637 INVESTIGATION OF THE ^{12}C(d,p)^{13}C REACTION NEAR THE DEUTERON ENERGY OF 1.2 MeV. Lemann, D.; Treffkorn, Kh. I. (Karl Marx Univ., Leipzig). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1870-1872(Sep 1973). (In Russian).

Resonances in the ^{12}C(d,p)^{13}C reaction were investigated by measurement of the angular distributions and proton polarization at incident energies of 1130 and 1170 keV. The values obtained were shown, and the experimentally obtained data on the polarization of the proton groups were compared with theoretical data. (3 figures) (JSR)

19638 QUASI-FREE ELECTRON SCATTERING FROM ^{12}C USING HARTREE-FOCK WAVE FUNCTIONS. Hasan, T.; Naqvi, J. H. (Aligarh Muslim Univ., India). Nucl. Phys.; A220: No. 1, 114-124(1974).

The energy spectrum and the angular correlation distributions

for the reaction $^{12}C(e,e'p)^{11}B$ are calculated within the framework of DWBA using spherical Hartree-Fock wave functions. A comparison with experiment and some of the earlier calculations is made. It is observed that a large spatial extent of the wave functions significantly improves the agreement. (auth)

19639 IMPORTANCE OF SECOND-ORDER PROCESSES IN PARTICLE TRANSFER REACTIONS. Stamp, A. P. (Oxford Univ.). Nucl. Phys.; A220: No. 1, 137-165(1974).

If second-order processes involving inelastic excitations are important in direct reactions it follows there will be resonances in certain direct reaction channels. The existence of such resonances is discussed, particular reference being made to the $^{12}C(d,p)^{13}C^*$ reactions. It is argued that the existence of such resonances implies that second-order processes should be included when analyzing direct reactions. (auth)

19640 STUDY OF THE REACTIONS $^{12}C(d,d)^{12}C$ AND $^{12}C(d,p)^{13}C$ ACROSS THE RESONANCE AT $E_d = 2.71$ MeV. Davison, N. E.; Fintz, P.; Gallmann, A. (Univ. Louis Pasteur, Strasbourg). Nucl. Phys.; A220: No. 1, 166-172(1974).

The second order processes in particle transfer reactions are tested by measuring the resonance structure of the 3^+ state of ^{14}N at 12.61 MeV for some outgoing channels of the $^{12}C + d$ reaction. (auth)

19641 SINGLET DEUTERON EFFECTS IN THE (p,pn) REACTION. Avakov, G. V.; Belyaeva, E. S.; Dolinskii, E. I. (Moscow State Univ.). Nucl. Phys.; A220: No. 1, 205-216(1974).

Singlet deuteron (d) effects in the (p,pn) reaction on light nuclei are studied within the framework of the dispersion theory of direct interactions. Simple analytical expressions are derived for the differential cross sections for the (p,pn) and (p,d) reactions assuming the pole knock-out mechanism and the peripheral partial wave dominance. The results of calculations are generally in good agreement with the experimental data of Cohen et al. (auth)

19642 WIDTH OF THE 6.20 MeV, $J^\pi = 1^-$, LEVEL OF ^{18}O. Hass, M. (Weizmann Inst. of Science, Rehovot, Israel); Shkedi, Z.; Start, D. F. H.; Wolfson, Y.; Horowitz, Y. S. Nucl. Phys.; A220: No. 1, 217-220(1974).

The width of the 6.20 MeV, $J^\pi = 1^-$ state of ^{18}O was measured using a resonance fluorescence self-absorption technique. For a ground state branching ratio, $\Gamma_0/\Gamma = 0.88$, one finds $\Gamma_0 = 180 \pm 30$ MeV. The energy of this state was determined to be 6202.7 ± 0.8 keV. (auth)

19643 CHARGE AND CURRENT DISTRIBUTIONS IN ELASTIC ELECTRON SCATTERING BY 1p SHELL NUCLEI. Bernabeu, J. (CERN, Geneva); Ros, J. Nucl. Phys.; A220: No. 1, 1-12(1974).

The charge and magnetic form factors appearing in elastic electron scattering by 1p shell nuclei are studied. The question that the form factors may be obtained from simple nuclear models by simply introducing a scaling factor was examined using the j-j coupling, the L-S coupling and the intermediate coupling of Cohen-Kurath (CK) resulting from effective interactions. Results for ^6Li, ^7Li, ^9Be and ^{12}C are given and the q^2 dependences of their form factors are compared in the three models and with experiment. The CK scheme gives similar results to the L-S coupling for ^6Li and ^7Li, in agreement with experiment, whereas it is intermediate between j-j and L-S couplings in ^9Be and ^{12}C. (auth)

19644 DOUBLE-NUCLEON EMISSION FOLLOWING PION ABSORPTION WITH A THREE-BODY DESCRIPTION OF THE FINAL STATE. Garcilazo, H. (Univ., Mainz); Eisenberg, J. M. Nucl. Phys.; A220: No. 1, 13-30(1974).

The absorption of a bound negative pion by a nucleus generally results in the emission of two nucleons, thus, with the residual nucleus, forming a three-body system in the final state. The theory of such systems based on the Faddeev equations is presented, and is adapted for use in nuclear reactions leading to the simultaneous emission of two nucleons. Numerical results are presented for double-neutron emission following pion absorption in ^{12}C, using one-term separable potentials to simulate the neutron-nucleus interaction in several partial waves, and a two-term separable potential for the nucleon-nucleon interaction to include effects of a repulsive core. The consequences of the nucleon-nucleon short-range correlations inside the nucleus are studied. (auth)

19645 THREE-BODY FORCES AND THE 6.06 MeV 0^+ EXCITED STATE IN OXYGEN 16. Nash, G. F. (Rudjer Boskovic Inst., Zagreb). Nuovo Cim.; 19A: No. 3, 352-364(1 Feb 1974).

The contribution to the excitation energy of the four-particle-four-hole configurations in oxygen 16 was calculated exactly using a separable three-body potential. The extra potential energy obtained, some five MeV, made up most of the deficit between the theoretical excitation energy of this state found from two-body forces and experiment. (auth)

19646 YIELDS OF SHORT-LIVED NUCLEI IN SPALLATION REACTIONS ON CARBON, OXYGEN, AND ALUMINUM. Batist, L. Kh.; Berlovich, E. E.; Blinnikov, Yu. S.; Elkin, Yu. V.; Novikov, Yu. N.; Ovchinnikov, B. M.; Tarasov, V. K. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1944-1946(Sep 1973). (In Russian).

The yields of a series of radioactive nuclei with half-lives $\lesssim 3$ min formed during the bombardment of C, O, and Al with 1-GeV protons were studied. The results are tabulated and show satisfactory agreement between experimental and calculated values in the region of large masses of the product nuclei. (1 figure, 3 tables) (JSR)

19647 ANALYSIS OF α-DECAY WIDTHS OF LIGHT 4n NUCLEI. Arima, A. (State Univ. of New York, Stony Brook); Yoshida, S. Nucl. Phys.; A219: No. 3, 475-515(1974).

Previous analyses of the α-widths of the ground state band of ^{20}Ne are extended to most data for ^{20}Ne, ^{16}O, and ^{12}C. The simple prescription that the spectroscopic favor is the ratio of the observed width to the single particle width calculated by a Woods-Saxon potential, is re-examined using R-matrix theory. Especially, the effects of antisymmetrization, the energy shift correction, and the energy dependence of the hard sphere scattering phase shift are taken into account. For narrow resonances the simple prescription gives good results, while for broad resonances the two latter effects are found important. A new formula was obtained for the spectroscopic factor which depends on the choice of the channel radius. The optimum value of the channel radius is also discussed. For levels whose nature is well known, generally good agreement with shell model predictions was obtained. For levels whose nature is not well known, the extracted spectroscopic factors are used to identify the band structure. (auth)

19648 SHELL MODEL PREDICTIONS OF THREE- AND FOUR-PARTICLE CLUSTERS TRANSFER SPECTROSCOPIC FACTORS IN SOME s-d AND f-p SHELL NUCLEI. McGrory, J. B. (Oak Ridge National Lab., TN). Phys. Lett.; 47B: No. 6, 481-483(24 Dec 1973).

The intensity of the leading SU(3)-representation in the low-lying eigenstates of ^{19}F, ^{20}Ne, ^{36}Ar, ^{37}K, ^{43}Sc and ^{44}Ti is used to estimate three- and four-particle cluster transfer spectroscopic factors to these states. (auth)

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Refer also to abstracts 19619, 19620, 19628, 19629, 19646–19648, 19666, 19668, 19692, 19696, 19705, and 19837.

19649 (AECL-4657, p 30) HALF-LIVES OF ^{22}Na, ^{54}Mn; AND ^{139}Ce. Merritt, J. S.; Taylor, J. G. V. Oct 1973.

19650 (COO-1779-128, pp 13-14) SHELL MODEL PREDICTIONS FOR THE DECAY SCHEMES OF EXOTIC OXYGEN AND FLUORINE ISOTOPES. Lanford, W. A.; Wildenthal, B. H. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19651 (COO-1779-128, pp 34-35) STUDY OF THE (p,^{3}He) AND (p,t) REACTIONS ON ^{29}Si AND ^{31}P. Nann, H.; Benenson, W.; Lanford, W. A. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19652 (COO-1779-128, p 45) FERMI BETA DECAY AND THE MASSES OF ^{32}Mg, ^{36}Si, ^{38}S, AND ^{34}Ar. Hardy, J. C.; Schmeing, H.; Benenson, W.; Crawley, G. M.; Kashy, E.; Nann, H. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19653 PRE-COMPOUND EMISSION MECHANISM IN NUCLEAR REACTIONS. Milazzo Colli, L.; Braga Marcazzan, G. M. (CISE, Milan). Riv. Nuovo Cim.; 3: No. 4, 535-555(1973).

The pre-compound emission probability in nuclear reactions is calculated. Comparison is made with (n,p) and (n,n') reactions, alpha emission reactions, and with absolute cross sections of (n,α) and (p,α) reactions. (JFP)

19654 INELASTIC ELECTRON SCATTERING FROM $^{20,22}Ne$. Singhal, R. P. (Linear Accelerator Lab., Saskatoon, Saskatchewan); Caplan, H. S.; Moreira, J. R.; Drake, T. E. Can. J. Phys.; 51: No. 20, 2125-2137(15 Oct 1973).

The scattering of electrons from the low lying excited states of ^{20}Ne and ^{22}Ne was studied in the momentum transfer range from

0.41 fm^{-1} to 1.04 fm^{-1}. Over a limited range of momentum transfer the study of ^{20}Ne was extended to excited states up to 8 MeV. A phase shift code was used to extract the ground state transition probabilities of the states observed. The model dependence of the results is investigated. The experimental results were compared with the predictions of the Nilsson and the alpha-particle model. (auth)

19655 SHAPE-EXCITED STATES OF ^{28}Si. Kulkarni, D. R.; Pandya, S. P. (Physical Research Lab., Ahmedabad, India). Pramana; 1: No. 6, 269-273(Dec 1973).

The Hartree-Fock (HF) minima for the nucleus ^{28}Si were obtained for the prolate, oblate, and spherical shapes by using the interaction obtained by Preedom and Wildenthal. The interaction gives rise to large energy separation between the prolate and the oblate shapes. The spherical solution is just 2 MeV above the lowest HF (oblate) minimum. The spectrum projected from the oblate HF state is in good agreement with the experimental spectrum. The transition probabilities for the different energy levels also agree reasonably well. The configuration-mixing calculations performed on the basis of states projected from the three shapes indicate that there is no significant mixing of different projected states. The second 0_2^+ state thus obtained corresponds to the third 0_3^+ state in the experimental spectrum, and stems dominantly from the spherical HF state. It is seen that the structure of the energy levels of ^{28}Si, especially the second 0_2^+ level, is very sensitive to the two-body interaction. The results are compared with those obtained using the renormalized interaction of Kuo. (1 figure, 2 tables) (auth)

19656 MAGNETIC MOMENT MEASUREMENT OF A VERY SHORT-LIVED STATE ($^{24}Mg, 2_1^+$). Horstman, R. E.; Eberhardt, J. L.; Doubt, H. A.; Van Middelkoop, G. (Univ., Utrecht, Netherlands). Phys. Lett.; 48B: No. 1, 31-32(7 Jan 1974).

The magnetic dipole moment of the 1.37 MeV $J^\pi = 2^+$ state (with $\tau_m = 1.75 \pm 0.08$ ps) was measured with the time-differential recoil-into-vacuum technique for single-electron ions. The value of the g-factor obtained, $|g| = 0.44 \pm 0.04$, is lower than theoretical predictions. (auth)

19657 1522 keV TRANSITION IN ^{28}Si. Carlson, L. E.; Branford, D.; Huang, F. C. P.; Ophel, T. R. (Australian National Univ., Canberra). Particles Nucl.; 6: No. 2-3, 76-81(1973).

Gamma-gamma directional correlation measurements on the γ-rays from the 1024 keV resonance in the $^{27}Al(p,\gamma)^{28}Si$ reaction are described. A result of $\tan^{-1}\delta = -68° \pm {}^{+9}_{-13}$ was obtained for the E2/M1 mixing ratio for the decay of the 7798 keV 3^+ level. This result is discussed with regard to the amplitude of T = 1 admixture into these states, the SU_3 model and a recent shell model calculation. (auth)

19658 DETERMINATION AND DWBA ANALYSES OF TRANSITION MATRIX ELEMENTS IN THE REACTION $^{26}Mg(\alpha,\alpha'\gamma)^{26}Mg$. Wagner, H.; Hofmann, A.; Vogler, F. (Univ. Erlangen-Nuernberg, Erlangen, Ger.). Phys. Lett.; 47B: No. 6, 497-500(24 Dec 1973).

Various DWBA calculations, which describe the inelastic cross section of the $^{26}Mg(\alpha,\alpha')$ reaction quite well, cannot reproduce the angular distribution of transition matrix elements, measured by in-plane $\alpha-\gamma$ angular correlations. (auth)

19659 ISOSPIN STRUCTURE OF THE ENERGY LEVELS OF THE ^{32}S NUCLEUS FROM PROTON RADIATIVE CAPTURE REACTIONS. Kostin, V. Ya.; Kopanets, E. G.; Koval, A. A.; L'vov, A. N.; Migalenya, V. Ya.; Tsytko, S. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1895-1899(Sep 1973). (In Russian).

The $^{31}P(p,\gamma)^{32}S$ reaction was studied in the proton energy range $E_p = 1.8$ to 2.7 MeV. The decay schemes of 10 resonance levels were determined. Experimental values were obtained for the matrix elements of the dipole transitions. The levels at 10.826 MeV (E_p = 2023 keV) and 10.918 MeV (E_p = 2118 keV) were interpreted as T-mixed doublets. (2 figures, 2 tables) (tr-auth)

19660 ELASTIC AND INELASTIC SCATTERING OF α PARTICLES WITH ENERGY OF 24.2 MeV ON ^{34}S NUCLEI. Antropov, A. E.; Vasil'ev, S. I.; Zarubin, P. P.; Kukhtina, I. N.; Orlov, B. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1873-1879(Sep 1973). (In Russian).

The angular distributions of elastically scattered α particles with energy of 24.2 MeV on ^{34}S nuclei at angles of 30 to 175° (center-of-mass system) and of inelastic scattering with excitation of the first and second 2^+ states of ^{34}S at angles from 20 to 175° (center-of-mass system) were obtained. The combined angular distribution, corresponding to the excited states 0^+ and 2_2^+, was also measured at angles from 70 to 175°. (4 figures, 2 tables) (auth)

19661 ANALYSIS OF THE METHOD OF ATTENUATED DOPPLER SHIFT CONSIDERING THE DISCONTINUOUS SLOWING DOWN PROCESS. Kregar, M.; Kump, P.; Pavshich, M.; Vaksel, M. (Jozef Stefan Inst., Ljubljana, Yugoslavia). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1835-1838(Sep 1973). (In Russian).

In the calculation of the lifetimes of excited states it is proposed that the discontinuous slowing-down process be considered when the Doppler shift method is used. The analysis of the proposed method showed that accurate values of the lifetimes of excited states can be obtained by analysis of the shape of the γ lines in those cases when the mechanism for the slowing down of the ions is known. (3 figures) (JSR)

19662 MEASURING NUCLEAR EXCITATION ENERGIES AND Q-VALUES WITH A CYCLOTRON-MAGNETIC SPECTROGRAPH SYSTEM. Nolen, J. A. Jr.; Hamilton, G.; Kashy, E.; Proctor, I. D. (Michigan State Univ., East Lansing). Nucl. Instrum. Methods; 115: No. 1, 189-196(1974).

Nuclear excitation energies and reaction Q-values were measured with the M.S.U. cyclotron-magnetic spectrograph system with uncertainties on the order of 1 keV or less. The method involves a spectrograph calibration procedure which utilizes a combination of momentum-matching and kinematics techniques. The calibration lines used in the present work are independent of any previous spectrograph based on the $^{210}Po(\alpha)$ energy scale. The present work is also largely independent of Ge(Li) gamma detector measurements, and provides independent consistency checks on previous measurements at the 1-keV uncertainty level. Sample results include checks on the excitation energies of the first excited state of ^{12}C and the third excited state of ^{24}Mg. The excitation energy of the first excited state of ^{11}C and the Q-values for the reactions $^{24}Mg(p,d)^{23}Mg$ and $^{24}Mg(p,t)^{22}Mg$ are also presented. (4 figures, 4 tables) (auth)

19663 M1 DECAY OF ISOBARIC-ANALOG STATES IN ^{31}P, ^{49}Sc, ^{61}Cu, AND ^{37}Cl NUCLEI. Aleshin, V. P. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1959-1966(Sep 1973). (In Russian).

The polarization of the core being taken into account, the partial widths of M1 transitions from analog states to antianalog states were calculated for the $1f_{\frac{1}{2}}$, $2p_{\frac{1}{2}}$, $1g_{\frac{9}{2}}$, and $1f_{\frac{7}{2}}$ analog states for ^{31}P, ^{49}Sc, ^{61}Cu, and ^{37}Cl, respectively. The energies of the core polarization states were evaluated as E_c = 8, 6.7, 6.8, and 6.7 MeV for ^{31}P, ^{49}Sc, ^{61}Cu, and ^{37}Cl, respectively. It was shown that realistic forces lead to formation of giant resonances in the region of spin-flip states. (3 figures, 6 tables) (tr-auth)

19664 STUDY OF EXCITED STATES IN ^{33}Cl BY ELASTIC PROTON SCATTERING ON ^{32}S. Fifield, L. K.; Poletti, A. R. (Univ. of Auckland, New Zealand). Nucl. Phys.; A220: No. 1, 183-190(1974).

The properties of resonance levels in ^{33}Cl were deduced from proton elastic scattering on ^{32}S. Proton bombarding energies in the ranges 3.36 to 3.40 MeV, and 3.8 to 5.0 MeV were covered, and the elastically scattered protons were observed at four angles. The excitation energies, J^π values, and widths of ten ^{33}Cl levels are reported. (auth)

19665 MAGNETIC MOMENT OF THE 22 μs ISOMERIC STATE IN ^{36}K. Iordachescu, A.; Ivanov, E. A.; Pascovici, G. (Inst. of Atomic Physics, Bucharest). Phys. Lett.; 48B: No. 1, 28-30(7 Jan 1974).

The g-factor of the $\tau_{\frac{1}{2}} = 22$ μs, $J^\pi = (7^+)$, T = 0 isomeric state at 3.46 MeV in ^{36}K was measured by the differential spin precession method with the $^{35}Cl(\alpha,n)^{38}K$ reaction. The result of $g = +0.548 \pm 0.002$ ($\mu = +3.836 \pm 0.014$ n.m.) is consistent with a pure $f_{\frac{7}{2}}^2$, $J^\pi = 7^+$ configuration. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 19620, 19653, 19666, 19671, 19684, 19691, 19693, 19696, 19705, 19708, 19729, 19735, and 19798.

19666 (AE-481) NEUTRON INELASTIC SCATTERING CROSS SECTIONS IN THE ENERGY RANGE 2 TO 4.5 MeV. Measurements and Calculations. Etemad, M. A. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 61p. Dep. NTIS (U. S. Sales Only) $5.25.

Fast-neutron inelastic scattering cross sections were measured for the elements Al, Ti, V, Mn, Fe, Ni, Nb, Pb, Pb_2, and Bi by the time-of-flight technique. The measurements were made in the energy range of 2 to 4.5 MeV in steps of 0.25 MeV and at a scat-

tering angle of 125°. Furthermore, angular distributions were measured for all elements, except V, at a neutron energy of 3.02 MeV. The inelastic cross sections were determined relative to the well known n–p cross sections by measuring the neutron scattering from hydrogen in the form of a polythene sample. The measured cross sections were corrected for the effects of the anisotropic intensity distribution of the neutron source, attenuation of the neutron flux in the sample, and multiple scattering of the neutrons, by using Monte Carlo techniques. The experimental results of the present work, together with those reported by other experimenters, were compared with the excitation functions calculated on the basis of the Hauser–Feshbach formalism and corrected for the effects of the level width fluctuations and resonance interference. For the elements Al, V, Fe, and Nb comparisons were also made between the excitation functions reported in this work and those compiled in the Evaluated Nuclear Data File (ENDF/B). (22 figures, 14 tables) (auth)

19667 (ANU-P-579) ENERGIES, DECAY SCHEMES, AND LIFETIMES OF LEVELS IN ^{34}Ar MEASURED USING THE ^{32}S(^{3}He, nγ)^{34}Ar REACTION. Bell, R. A. I.; Thompson, J. V.; Graham, I. G.; Carlson, L. E. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Sep 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Energies, gamma decay schemes and lifetimes of levels in ^{34}Ar have been measured using the DSAM and a neutron-gamma coincidence technique. Levels were populated by the ^{32}S(^{3}He,n) reaction with an 8-MeV He beam and a thick cooled sulphur target. A method of correcting observed F(τ) values for gamma cascades is described. The level energies and lifetimes deduced are: 2091.1 ± 0.3 keV (330^{+20}_{-30} fs), 3287.3 ± 0.5 keV (215^{+15}_{-15} fs), 3873 ± 3 keV, 4127.8 ± 1.0 keV (<350 fs), 4513.2 ± 0.8 keV (390^{+110}_{-110} fs). The measured lifetimes are on average 1.6 times longer than reported elsewhere using an Ag_2S target; this is discussed in the light of Broude's recent observations of DSAM lifetime dependence on stopping material. The ratio of isovector to isoscalar charge has been calculated for twelve E2 transitions in 4N + 2 nuclei and is found to imply almost equal effective proton and neutron charges. (auth)

19668 (BNL-tr-548) CONTRIBUTION OF DIRECT INTERACTIONS TO THE CROSS SECTIONS FOR NEUTRON SCATTERING BY Mg, Ti, Cr, ^{58}Ni, ^{60}Ni, AND ^{62}Ni NUCLEI. Sokolov, L. S.; Fedorov, M. B.; Korbetskii, E. V.; Surovitskaya, N. T.; Yakovenko, T. I. Translated by S. J. Amoretty from Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 2, 263-266(1973). 10p. Dep. NTIS $3.00.

The differential cross sections of potential scattering are calculated by means of a generalized optical model of a nucleus in assumption of vibrational nature of excited states. The angular distributions of the compound scattered neutrons are calculated by the Hauser–Feshbach statistical theory. The sum of potential and compound scattering is compared with the experimental data. The relation of the potential scattering and compound scattering cross sections are within the limits of 1 : 2 to 1 : 9 in case of inelastic scattering with excitement of states 2^+ and within the limits of 1 : 0.05 to 1 : 0.67 in case of elastic scattering. (auth)

19669 (BNL-tr-549) ANGULAR AND ENERGY DISTRIBUTIONS OF NEUTRONS INELASTICALLY SCATTERED BY Fe AND Ni NUCLEI. Tertychnyi, G. Ya.; Shubin, Yu. N. Translated by S. J. Amoretty from Yadern. Fiz.; 17: No. 2, 287-292(1973). 14p. Dep. NTIS $3.00.

Inelastic scattering of neutrons with energy 14 MeV on Fe and Ni nuclei is analyzed. To determine the mechanisms through which inelastic scattering goes and to detect the contribution of the process, which goes through a compound nucleus, calculations of angular and energy distributions of inelastically scattered neutrons were carried out on the basis of the Hauser–Feshbach statistical approach with a precise account of the contribution of each angular momentum. The calculation results point to the presence of weak anisotropy with respect to 90° angle. Unequilibrium process contribution, estimated in the Griffin model, at 90° is 25% for Fe and 20% for Ni. From comparison with the experiment, neutron energy distribution from (n,2n) and (n,pn) reaction, which gives the total cross section, coinciding with experiment was obtained. (auth)

19670 (COO-1779-128, pp 4-5) ELECTROEXCITATION AND (p,p′) CROSS-SECTION TO GIANT RESONANCES: MICROSCOPIC THEORY CALCULATIONS. Hammerstein, G. R.; McManus, H.; Moalem, A. Oct 1973.
In annual report, July 1, 1972–July 1, 1973.

19671 (COO-1779-128, pp 24-29) NEUTRON TIME-OF-FLIGHT PROGRAM. Branson, J. G.; Doering, R. R.; Galonsky, A.; Patterson, D. M. Oct 1973.
In annual report, July 1, 1972–July 1, 1973.

19672 (COO-1779-128, pp 36-37) STRUCTURE OF ^{56}Ni VIA THE ^{58}Ni(p,t)^{56}Ni REACTION. Nann, H.; Benenson, W. Oct 1973.
In annual report, July 1, 1972–July 1, 1973.

19673 (COO-1779-128, pp 40-41) (^{3}He,^{7}Be) REACTION AT 70 MeV. Steele, W. F.; Crawley, G. M.; Maripuu, S. Oct 1973.
In annual report, July 1, 1972–July 1, 1973.

19674 (COO-1779-128, pp 48-49) EXCITED STATES OF ^{49}V. Samuelson, L. E.; Kelly, W. H.; Warner, R. A.; McHarris, W. C. Oct 1973.
In annual report, July 1, 1972–July 1, 1973.

19675 (NP-19939) ANNUAL REPORT, 1971. Karmohapatro, S. B.; Poddar, R. K. (Eds.). (Saha Inst. of Nuclear Physics, Calcutta (India)). 1971. 229p. Dep. NTIS (U. S. Sales Only) $13.50.

This volume contains a resume of activities during the year 1971. After a general introduction, various numbers of short reports are given by the following groups and divisions: Accelerator group (Cyclic accelerator division, Electrostatic accelerator division, Nuclear chemistry division, Mass spectroscopy and isotope separator), Nuclear physics group (Nuclear Physics division, Crystallography and molecular biology division, Teaching division), Biophysics division, Theoretical nuclear physics division, Instrumentation division, Director's research group, and Workshop. Lists of publications, theses, and staff and similar items appear in appendices. (RWR)

For title listings of selected papers see: 19362, 19607, 19676, and 19677.

19676 (NP-19939, pp 26-28) DECAY OF ^{48}Sc. Tikku, V. K.; Singh, H.; Sethi, B. 1971.

19677 (NP-19939, pp 150-155) MICROSCOPIC CALCULATION ON THE ISOBARIC ANALOGUE RESONANCE IN THE REACTION ^{51}V(p,n)^{51}Cr. Pal, D.; Krishna, K. 1971.

19678 PHOTONEUTRON DISINTEGRATION OF ^{40}Ar. Jury, J. W. (Trent Univ., Peterborough, Ont.); Lodge, J. L.; Lokan, K. H.; Sherman, N. K.; Gellie, R. W. Can. J. Phys.; 51: No. 11, 1176-1181(1 Jun 1973).

Photoneutron energy spectra from ^{40}Ar were measured at bremsstrahlung end-point energies from 13 to 23 MeV in 1 MeV steps. The differential cross section at 90° for the reaction ^{40}Ar(γ,n_0)^{39}Ar revealed some 26 previously unreported excited states of ^{40}Ar in the region below 13 MeV. The envelope of these states suggests a single particle resonance involving the valence 1 $f_{\frac{1}{2}}$ neutrons. The measured total neutron cross section exhibits a marked change from this single particle behavior at about 14 MeV where collective effects begin to dominate and neutrons are emitted to highly excited states of ^{39}Ar. (auth)

19679 DECAY MODES AND LIFETIMES OF LEVELS IN ^{39}K BELOW 7.3 MeV EXCITATION. Durell, J. L. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Metag, V.;Repnow, R.; James, A. N.; Sharpey-Schafer, J. F.; von Brentano, P. Nucl. Phys.; A219: No. 1, 1-19(1974).

Levels in ^{39}K were populated using the (p,p′γ) reaction and the decays of levels below 7.3 MeV were established by a particle-gamma coincidence experiment. The mean lifetimes of 24 levels have been determined in a singles experiment using the Doppler shift attenuation method. Limits on the lifetimes of a further 10 levels in ^{39}K were obtained. Discussion of the properties of levels in ^{39}K is given. (auth)

19680 EXCITATION OF THE K = 0⁻ ROTATIONAL BAND IN ^{44}Sc WITH THE REACTION ^{44}Ca(p,n)^{44}Sc AT LOW ENERGY. Brandolini, F. (Univ., Padua). Lett. Nuovo Cim.; 9: No. 1, 29-31(5 Jan 1974).

A sequence of negative levels in ^{44}Sc was recently identified at 68 keV (1⁻), 235 keV (2⁻), 425 keV (3⁻) and 631 keV (4⁻); it was suggested that they belong to a k = 0⁻ band, whose head term 0⁻ is the level at 146 keV. The 0⁻ assignment was based on the fact that the 146 → 68 keV transition has a predominantly M1 internal-conversion coefficient, so spins 0⁻, 1⁻, 2⁻ are left; then 1⁻ and 2⁻ were excluded on the basis of an argument based on the analysis of the 146 → 68 → 0 cascade. An independent way to discriminate between the 1⁻ and 0⁻ assignments is proposed, which consists in comparing the excitation functions of levels at 68 and 146 keV in the reaction ^{44}Ca(p,n). The analysis is based on the statistical model. (LBS)

19681 INTERACTION POTENTIAL FOR HEAVY-ION SCATTERING. Brink, D. M.; Rowley, N. (Oxford Univ.). Nucl. Phys.; A219: No. 1, 79-92(1974).

The long-range part of the nucleus-nucleus interaction is taken to be given by folding the density distribution of one nucleus with the real part of the single-nucleon optical potential of the other.

Analytic approximations are derived for the folded potential and its derivative in the case where the density distribution and single-nucleon optical potential have Saxon-Woods form factors of equal surface thickness. The approximations are generalized to the case of different surface thicknesses and are compared with a previous parametrization due to Broglia and Winther. The variation with mass number of the central density of the Saxon-Woods matter distribution required to obtain the correct normalization is shown to be large and an expression for the variation is given. Some calculations are performed on various elastic scattering data using the "quarter-point recipe" of Frahn's diffraction theory. The parameters required to fit the quarter-points of the elastic cross sections are shown to be consistent with their accepted values. It is shown, however, that the quarter-point recipe leads to a larger radius for ^{208}Pb than for ^{232}Th. The positions and heights of the pure Coulomb barrier (L = 0) are evaluated for various nuclei. The barrier radii are found to be sufficiently large to suggest that an interaction of the folded type should be reasonable in this region. (auth)

19682 SPIN-PARITY DETERMINATION FROM NEUTRON THRESHOLD MEASUREMENTS AND THE SECOND EXCITED STATE OF ^{44}Sc. Morinaga, H. (Univ., Munich); Huber, R. B.; Morando, M.; Ricci, R. A.; Signorini, C. Nuovo Cim.; 18A: No. 4, 593-600(21 Dec 1973).

The "counter ratio method", i.e., the ratio between slow- and fast-neutron yields was used in the ^{44}Ca(p,n)^{44}Sc reaction to assign spin and parities to some ^{44}Sc levels. The method is presented as an useful tool for spin-parity assignments in the case of odd–odd nuclei formed through (p,n) reactions. The ^{48}Ti(p,n)^{48}V reaction is discussed as an example. The ^{44}Ca(p,n)^{44}Sc reaction was investigated by using the proton beam of the Van de Graaff accelerator of the Laboratori Nazionali di Legnaro. The results are consistent with the following spin-parity assignments to ^{44}Sc levels: ground state (2^+), 68 keV state (1^-), 146 keV (0^-), 667 keV (1^+). Of special interest is the 0^- assignment to the second excited state at 146 keV. (auth)

19683 CHARGE DISTRIBUTIONS OF THE ISOBAR PAIR ^{40}Ar–^{40}Ca FROM A PHENOMENOLOGICAL AND A MODEL-INDEPENDENT ANALYSIS OF ELASTIC ELECTRON SCATTERING. Wendling, R. D.; Walther, V. H. (Univ., Mainz). Nucl. Phys.; A219: No. 3, 450-460(1974).

Cross sections for elastic electron scattering from ^{40}Ar were measured for the momentum transfer range from 0.8 to 1.8 fm^{-1}. The data were analyzed by various phenomenological models as well as by a model-independent method. Using the results of Stanford measurements on ^{40}Ca analyzed in a similar matter, the difference of the charge distributions of ^{40}Ar and ^{40}Ca was calculated. The combined results of the phenomenological analysis are compared with the results of the model-independent analysis. (auth)

19684 EXCITATION OF COLLECTIVE NUCLEAR STATES BY HIGH ENERGY PARTICLES. Starodubskii, V. E. (Leningrad Nuclear Physics Inst.). Nucl. Phys.; A219: No. 3, 525-542(1974).

The excitation of collective nuclear states by high energy particles is considered within the framework of the Glauber theory. The approach is based on the adiabatic approximation and expansion of the scattering amplitude in powers of the nonsphericity parameter. The formulas for the excitation cross sections of the rotational and one- and two-phonon vibrational states, as well as the elastic scattering cross section with the collective motion included, are obtained. The effect of nucleon correlations in both elastic and inelastic cross sections is also studied. The theoretical predictions are compared to new data on 1 GeV proton scattering by ^{58}Ni, ^{208}Pb, ^{12}C, ^{40}Ca and ^{39}K. A comparison with electron scattering data is simultaneously carried out. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 18421, 19653, 19663, 19666, 19668, 19693, 19696, 19705, and 19729.

19685 (COO-1779-128, p 43) MASS AND ENERGY LEVELS OF ^{64}Ga. Robertson, R. G. H.; Benenson, W. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19686 (ZFK-215) COMPARISON OF (d,p) AND (n,γ) REACTIONS ON THE NUCLEI ^{58}Ni, ^{60}Ni, ^{62}Ni, AND ^{64}Ni. Gippner, P.; Jaeger, H. U.; Rudolph, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jun 1971. 73p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis. Submitted by P. Gippner to Technische Univ., Dresden (East Germany).

Using a 5.5 cm^3-Ge(Li)-detector the thermal neutron capture γ-ray spectra of the reactions ^{58}Ni(n,γ)^{59}Ni, ^{60}Ni(n,γ)^{61}Ni, ^{62}Ni(n,γ)^{63}Ni and ^{64}Ni(n,γ)^{65}Ni were studied by straight spectroscopy. The reduced intensities $I\gamma/E\gamma^3$ have been compared with the $(2I_f + 1)S$ values of the $l_n = 1$ levels determined in the (d,p) reaction. This comparison shows, that for the low-lying states of ^{59}Ni and ^{61}Ni the primary γ-radiation mostly populates the components "target ground state + p-neutron." A good correlation between $I\gamma/E\gamma^3$ and $(2I_f + 1)S$ values for $l_n = 1$ levels of ^{59}Ni and ^{61}Ni has been found. This correlation and an analysis of the thermal neutron cross section suggest a contribution of potential capture in the ^{58}Ni(n,γ)^{59}Ni and ^{60}Ni(n,γ)^{61}Ni reactions. In the case of ^{63}Ni the comparison of (d,p) and (n,γ) probabilities indicates, that not only the component "target ground state + p-neutron" of the low-lying states is populated by the capturing state. For instance it seems possible to populate the term "first excited target state + p-neutron," by the component "first excited target state + d-neutron" of the capturing state. The remarkable differences between the ground state and first excited state transitions can be explained by coherent influence of certain terms in the B(E1) matrix elements. Assuming a ^{56}Ni core shell model calculations were made in the region of ^{59}Ni to ^{65}Ni. Effective two particle matrix elements are used. The observed wave functions allow a qualitative discussion of the components "target state + j-neutron" (j = $p_{3/2}$, $f_{5/2}$, $p_{1/2}$) in the low-lying states of ^{59}Ni, ^{61}Ni, ^{63}Ni, and ^{65}Ni and a conclusion on the capture mechanism in the examined reactions. (auth)

19687 NEUTRON TOTAL AND SCATTERING CROSS SECTIONS OF NIOBIUM IN THE CONTINUUM REGION. Smith, A. B.; Guenther, P. T.; Whalen, J. F. (Argonne National Lab., IL). Z. Phys.; 264: No. 5, 379-398(1973).

Neutron total and elastic and inelastic scattering cross sections of niobium are measured in the incident energy interval 0.25 to 0.5 MeV. Total neutron cross sections are determined to a few per cent accuracy throughout the energy interval. Differential elastic and inelastic neutron scattering cross sections are measured at approximately 20 scattering angles distributed between 20 and 160° and at incident neutron energy intervals of 0.1 MeV from 1.8 to 4.0 MeV. The cross sections for the inelastic neutron excitation of 11 states with Q-values of 2,520 keV are quantitatively measured and the excitation of an additional 8 states qualitatively observed. Calculations based upon a selected optical potential give a good description of total neutron cross sections to 20.0 MeV and of elastic scattering cross sections extending from low energies where compound-nucleus processes are prominent to high energies where "shape" scattering predominates. Inelastic neutron scattering cross sections are calculated from the optical potential and statistical theory and comparison with the corresponding experimental values suggests the spins and parities of the low-energy excited states. (GE)

19688 ELECTROMAGNETIC PROPERTIES OF LOW LYING LEVELS IN ^{75}As. Chopra, R. C.; Tandon, P. N. (Tata Inst. of Fundamental Research, Bombay). Pramana; 1: No. 2, 70-77(Aug 1973).

The g factors of the 265- and 280-keV levels were measured to be 0.61 ± 0.16 and 0.30 ± 0.05, respectively. The PAG technique was used for the measurements. In addition, the half-life of the 280-keV level was remeasured to be $T_{1/2}$ = 0.32 ± 0.02 ns by using γ–γ delayed coincidences. Electromagnetic properties of the various levels calculated on the core–particle coupling model agree with the experimental results. The results are compared with other existing theoretical calculations. (1 figure, 3 tables) (auth)

19689 ELECTRON CAPTURE DECAY OF ^{85}Sr. Vatai, E.; Xenoulis, A. C.; Baker, K. R.; Tolea, F.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Nucl. Phys.; A219: No. 3, 595-600(1974).

In order to resolve the controversy concerning the existence of an 868 keV γ-transition in the decay of 65d ^{85}Sr and to determine the electron capture decay energy, radiochemically separated sources, Ge(Li), Ge(Li)-NaI(Tl), and NAI(Tl)-NaI(Tl) spectrometers were used for singles and X-ray–γ and γ–γ coincidence measurements. A γ-ray at 868.5 ± 0.5 keV decaying with a 65 ± 5 d half-life was conclusively identified in ^{85}Sr decay. From measurements of the ratio $P_{K(868.5}/P_{K(514)}$ of K-capture probabilities by KX-ray–γ coincidences, a value of Q_{EC} was determined for the EC decay feeding the 868.5 keV transition. Thus, a level in ^{85}Rb is established at 868.5 keV, and an upper limit of 0.45 μsec is set on its lifetime. (auth)

19690 MEASUREMENTS OF THE TOTAL NEUTRON CROSS SECTION OF CHROMIUM, COBALT, AND ZIRCONIUM IN THE ENERGY RANGE 3 MeV TO 1 eV. Salama, M.; Adib, M.; Abdel-Kawi, A.; El-Miniaway, S.; El-Khosht, M.; Hamouda, I. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 22: No. 2, 87-89(Oct 1973).

Total cross section measurements were carried out for chromium, cobalt and zirconium in the energy range from 3 MeV to 1 eV. The measurements were performed using the time-of-flight spectrometer installed in front of one of the horizontal channels of the ET-RR-1 reactor. The cross section for chromium is well matched by the relation $\sigma_t = [(3.13 \pm 0.05) + (0.52 \pm 0.01)E^{-\frac{1}{2}}]$ barn, and for cobalt $\sigma_t = [(7.20 \pm 0.06) + (6.18 \pm 0.03)E^{-\frac{1}{2}}]$ barn. The measured cross section for zirconium is found to be energy independent and fluctuates near a constant value $\sigma_t = (6.80 \pm 0.10)$ barn. Values for absorption and potential scattering cross section were obtained. Crystal structure effects were observed in cases of chromium and zirconium. (GE)

19691 PRECISION NEUTRON TOTAL CROSS SECTION MEASUREMENTS ON GOLD AND COBALT IN THE 40 μeV–5 MeV RANGE. Dilg, W.; Mannhart, W.; Steichele, E.; Arnold, P. (Technische Univ., Munich). Z. Phys.; 264: No. 5, 427-444(1973).

The slow neutron absorption cross sections of gold and cobalt were accurately redetermined by transmission measurements in the neutron wavelength range 4 to 47 A. For the absorption cross sections were evaluated considering corrections for incoherent and inelastic scattering and for the slight deviation from $1/v$ of the absorption of gold due to the 4.9 eV resonance level. For the absorption at subthermal energies $\sigma_a/\lambda = (54.35 \pm 0.06)$ b/A for Au, (20.66 ± 0.04) b/A were obtained for Co. Evaluation of the absorption cross sections at 2,200 m/s neutron velocity gives (98.68 ± 0.12) b for Au, (37.15 ± 0.08) b for Co. (GE)

19692 MAGNETIC MOMENTS OF ODD–ODD NUCLEI WITH $A \leq 90$. Evstaf'ev, N. N.; Rozantsev, I. N. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1827-1832(Sep 1973). (In Russian).

The experimental and calculated values of the magnetic moments of odd–odd nuclei with $A \leq 90$ were compared, and their configurations were given. (1 table) (JSR)

Nuclear Properties and Reactions, $90 \leq A \leq 149$

Refer also to abstracts 19388, 19620, 19649, 19653, 19666, 19671, 19675, 19681, 19690, 19692, 19739, 19752, and 19781.

19693 (AE-482) NEUTRON ELASTIC SCATTERING MEASUREMENTS AT 7.0 MeV. Etemad, M. A. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Neutron elastic scattering measurements were performed on the elements As, Nb, Cd, Sb, Hf, Au, Pb, and Pb_r at 7.0 MeV neutron energy. Angular distributions were observed in the angular interval 20° to 160°. The experimental differential cross sections were compared with those predicted by the optical model in order to fix five adjustable parameters of the optical potential. Comparisons were also made between the angular distributions obtained by using these adjusted optical-model parameters and distributions calculated on the basis of generalized optical-model parameters. (8 figures, 12 tables) (auth)

19694 (AECL-4657) PHYSICS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1973. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 82p. (PR-P-99). Dep. NTIS (U. S. Sales Only) $6.25. AECL $2.00.

Work done in the nuclear physics, neutron and solid state physics, theoretical physics, and mathematics and computation branches is summarized in a number of brief reports. Tandem operation is described. A number of heavy-ion reactions are discussed, as well as sensitivity of light-emitting diodes to proton radiation damage. Studies on magnetic and vibrational excitations in various materials are mentioned. Research on high-purity Ge detectors is reported. The application of mathematics to various studies is recounted, along with a review of computer operations. (RWR)

For title listings of selected papers see: 19649, 19738, and 19759.

19695 (BARC-695) PROGRESS REPORT ON NUCLEAR DATA ACTIVITIES IN INDIA. IX. Balakrishnan, M.; Divatia, A. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 80p. Dep. NTIS (U.S. Sales Only) $6.00.

This report covers the work done during the year 1972. Brief summaries (generally a fraction of a page) on research done at twenty-five installations are included. (RWR)

19696 (BNL-325(3rd Ed.)(Vol.1)) NEUTRON CROSS SECTIONS. Volume I. Resonance Parameters. Mughabghab, S. F.; Garber, D. I. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1973. Contract AT(30-1)-16. 764p. (EANDC(US)-183-L; INDC(USA)-58-L). Dep. NTIS $13.60.

In contrast to earlier editions, which presented in compact form a summary of the complete store of the neutron data files, this edition aims to provide those portions of neutron data considered to be of prime importance and best suited for inclusion in ready reference form. This volume contains thermal cross sections, resonance properties, resonance parameters, and bibliography for nuclides from H to ^{257}Fm. Notation and nomenclature, considerations involved in the recommendations, and a table of energy-ordered resonances are also included. (RWR)

19697 (BNL-tr-556) ISOTOPIC EFFECTS OF THE STRENGTH FUNCTION NEAR THE MINIMUM. Nikolenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. Translated by S. J. Amoretty from JINR-P4-6947. 19p. Dep. NTIS $3.00.

An expression is obtained for the amplitude of the reduced width of the compound states in the framework of R-matrix theory with the wave functions antisymmetrized in all neutrons. Pair correlations of a superconducting type lead to an isotope shift in the strength functions. Calculation, performed for Sn and Te isotopes, agrees well with experiment. (3 figures) (auth)

19698 (COO-1779-128, p 46) ANOMALOUS ϵ/β^+ BRANCHING RATIOS IN ALLOWED TRANSITIONS. Firestone, R. B.; McHarris, W. C.; Kelly, W. H.; Warner, R. A. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19699 (COO-1779-128, pp 52-54) STUDIES OF ODD–ODD NUCLEI NEAR THE Z = 50 AND N = 82 CLOSED SHELLS. Chaffee, W. B.; Morgan, C. B.; Guile, J.; Warner, R. A.; Samuelson, L. E.; Kelly, W. H.; McHarris, W. C.; Bernstein, E. M.; Shamu, R. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19700 (COO-1779-128, pp 55-56) USING ^{140}Ce(p,nγ), ^{141}Pr(p,d), ^{139}La(α,3nγ), AND ^{142}Ce(p,3nγ) TO STUDY THE ODD–ODD NUCLEUS ^{140}Pr. Guile, J.; Morgan, C. B.; Warner, R. A.; Goles, R. W.; McHarris, W. C.; Kelly, W. H.; Bernstein, E. M.; Shamu, R. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19701 (COO-1779-128, pp 57-58) DECAY CHAIN ^{143}Eu → ^{143}Sm → ^{143}Pm. Firestone, R. B.; McHarris, W. C.; Kelly, W. H. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19702 (JINR-E4-7454) INTERPLAY BETWEEN VALENCE-SHELL CLUSTERS AND VIBRATIONAL FIELD IN ^{94}Mo AND ^{95}Mo. Paar, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The properties of ^{94}Mo and ^{95}Mo nuclei which are typical representations of N = 52 and N = 53 nuclei, respectively, have been described in the cluster-field model in natural representation (without parameter fitting). The interplay between few valence-shell neutrons and vibrational degrees of freedom gives rise to the coexistence of quasi-vibrational, quasirotational and clustering phenomena. (auth)

19703 (MNC-4028-12, pp 42-48) DECAY OF ^{105}Ru TO LEVELS OF ^{105}Rh. Aras, N. K.; Walters, W. B. 1 Nov 1973.

In research in nuclear chemistry.

19704 TOPOGRAPHICAL MAPS OF THE NUCLEAR BINDING ENERGY SURFACE. Kravtsov, V. A.; Skachkov, N. N. (Polytechnic Inst., Leningrad). At. Data Nucl. Data Tables; 12: No. 2, 143-157(Sep 1973).

Topographical maps are presented which show lines of constant energy on the three-dimensional nuclear binding energy surfaces which would be obtained by plotting $a + bA - E_b$ as a function of $N - Z$ and A. Discontinuities in the patterns of these lines occur for Z = 4, 8, 10, 14, 20, 28, 40, 50, 66, 70, and 82 and for N = 4, 8, 10, 14, 20, 22, 28, 50, 82, 88, 114, 126, and 152. (1 figure, 4 maps) (auth)

19705 DELAYED NEUTRON PRECURSORS. Tomlinson, L. (Atomic Energy Research Establishment, Harwell, Eng.). At. Data Nucl. Data Tables; 12: No. 2, 179-194(Sep 1973).

Experimental data on delayed neutron precursors are compiled and evaluated. Where available, the following data are listed for each nuclide: half-life, neutron emission probability, total energy available for beta decay, neutron binding energy of the daughter nucleus, major peaks in the neutron spectrum, methods of identification and production. The literature survey ended in December 1972. (1 figure, 1 table) (auth)

19706 HALF-LIVES OF ^{121}Cd AND ^{121}In ISOMERS. Scheidemann, O.; Hageboe, E. (Univ. of Oslo). Inorg. Nucl. Chem. Lett.; 10: No. 1, 47-53(Jan 1974).

A half-life of 12.8^{+3}_{-4} sec has been reported for ^{121}Cd produced from fission, and half-lives of 12 ± 5 sec and 4.5 ± 0.4 sec following the decay of ^{121}Cd, with emission of γ-rays of 334,349, and 1039 keV, but is is believed that no assignments have been made of the half-lives of specific ^{121}Cd isomers. As regards ^{121}In several possible levels above the ground state have been reported, and 262,657 and 925 keV γ-rays following ^{121g}In decay, together with 60.9 keV γ-rays following ^{121m}In decay. Using the Isolde facility at CERN, molten Sn was irradiated at 1000°C with 600 MeV protons to produce Cd. After passing the isotope separator and beam handling system the ^{121}Cd activity was collected on a movable Al tape and transported to the detector position in less than 1 sec. The energies and relative intensities of the γ-rays following ^{121}Cd and ^{121}In decay were measured with a Ge(Li) detector, and the half-lives determined from individual γ-rays using multianalyses of the γ-spectra. Weighted mean values for ^{121}Cd were 4.8 ± 0.4 sec and 12.7 ± 0.5 sec, and for ^{121g}In 30.0 ± 0.2 sec. The 4.8 sec Cd isomer was considered to be the main precursor of the 30 sec ^{121g}In, and it is believed, from shell model predictions and in analogy with other odd A In isotopes, that the 4.8 sec isomer was $11/2^-$ ^{121m}Cd and the 12.7 sec isomer was $1/2^+$ ^{121g}Cd. (UK)

19707 NATURE OF THE ISOMERIC 6^+ STATE IN THE HEAVY DOUBLY-EVEN Te ISOTOPES. Degrieck, E. (Ecole Royale Militaire, Brussels); Berghe Vanden, G. Z. Phys.; 265: No. 4, 393-400(1973).

The isomeric 6^+ state in the heavy doubly-even Te isotopes was studied in the two-proton cluster core coupling model. The lifetime is calculated and compared to the experimental data. Reduced quadrupole transition probabilities for transitions between the first excited 2^+ state and the ground state are discussed. (GE)

19708 INTERNAL CONVERSION OF THE 161-keV and 223-keV TRANSITIONS IN ^{133}Cs. Freund, F. (Univ., Bochum, Ger.). Z. Phys.; 264: No. 3, 259-272(1973). (In German).

Using a Ge(Li)–Si(Li)-spectrometer the 161 keV and 223 keV transitions of ^{133}Cs were investigated. The K-conversion coefficients were deduced to be $\alpha_K = 0.205 \pm 0.007$ and $\alpha_K = 0.0743 \pm 0.0043$, respectively. The K/L ratio for the 161 keV transition is 4.72 ± 0.37. From the α_K-values, M1 penetration factors of $\lambda = 8.6 \pm 3.4$ and $\lambda = 7.8 \pm 3.0-2.8$ were deduced which are inconsistent with known data from angular correlation experiments ($\lambda = 40 \pm 10$ and $\lambda = 90 \pm 13$). The penetration factor from K/L-measurement for the 161 keV-transition is $\lambda = 52 \pm 19$. A theoretical reinvestigation of the formulas used in the literature appears recommendable. Furthermore, the K/L ratio of the 1,770 keV transition of ^{207}Pb was determined experimentally to be 5.52 ± 0.54. (GE)

19709 ROTATIONAL FLOW MODEL FOR SPECTRA OF DEFORMED NUCLEI IN THE RARE-EARTH REGION. Prakash, V. R.; Deshpande, V. K. (Indian Inst. of Tech., Kanpur). Can. J. Phys.; 51: No. 16, 1752-1756(15 Aug 1973).

The rotational flow model with a simple flow in two dimensions already proposed by Prakash et al. was extended to include flows in three dimensions with a constant vorticity. The kinetic energy of rotations and the form of Hamiltonian thus obtained compares closely with that of the rigid rotator, but gives different expressions for the principal moments of inertia for a deformed nucleus. The Hamiltonian is quantized in the angular momentum representation. The eigenfunctions are the familiar D functions. The vorticity constant for a nonaxially symmetric nucleus is found to depend both on the deformation parameter β and the asymmetry parameter γ. However, for spherical nuclei the flow becomes irrotational and thus accounts for the absence of rotational spectra in such nuclei. Taking into account the potential energy due to centrifugal stretching phenomenologically, calculations were done for rotational levels belonging to the first excited β-vibrational band. The results are in good agreement with the experiment for nuclei in the middle of the region $150 < A < 190$. The model presented here successfully reproduces the results reported earlier. (auth)

19710 CORRECTION TO THE GOVERNOR MODEL MOMENT OF INERTIA. Prakash, V. R. (Indian Inst. of Tech., Kanpur). Can. J. Phys.; 51: No. 16, 1794-1795(15 Aug 1973).

It is shown that the expression for the moment of inertia used in the governor model calculations is incorrect. A correct expression for the moment of inertia is derived from first principles and is found to differ from the earlier, approximately by a factor of 1/2. This introduces a significant correction in the calculation of the number of nucleons outside the rotationally invariant core and the possible closed shell configuration given by Trainor and Gupta. (auth)

19711 COMPOUND-NUCLEUS MECHANISM FOR THE (p,np) REACTION NEAR THE NEUTRON THRESHOLD. Agassi, D.; Vager, Z. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; A218: No. 3, 573-605(1974).

A compound-nucleus mechanism is considered for the reaction where the isobaric analog resonance (IAR) is populated by a (p,n) stage and decays later emitting a proton $\vec{p}$. It is shown that this mechanism leads to an enhancement in the $\vec{p}$ spectra near the IAR energy of the type expected from $t_- T$ charge exchange. This phenomenon is general, and will occur whenever the analog state is not populated selectively in the entrance channel. For the case ^{91}Zr(p,np) ^{90}Zr(g.s.), the contribution to the cross section due to this mechanism is estimated. It is found that the model reproduces the shape of the measured cross section and a normalization consistent with the uncertainties of the data. In order to handle fine-structure properties of the IAR, a version of the external-mixing model particularly adapted for these purposes is developed. (6 figures, 1 table) (auth)

19712 GIANT DIPOLE RESONANCE OF VIBRATIONAL NUCLEI IN THE $103 \leq A \leq 133$ MASS REGION. Lepretre, A. (CEN de Saclay, Gif-sur-Yvette, France); Beil, H.; Bergere, R.; Carlos, P.; de Miniac, A.; Veyssiere, A.; Kernbach, K. Nucl. Phys.; A219: No. 1, 39-60(1974).

A set of experimental data concerning the giant dipole resonance of nuclei (GDR) in the $103 \leq A \leq 133$ mass region is presented. The cross sections $\sigma(\gamma,n)$ and $\sigma(\gamma,2n)$ were obtained in the energy region 8–30 MeV by means of a monochromatic photon beam produced by annihilation in flight of positions. An interpretation of the experimental behavior of the GDR for vibrational nuclei in the $103 \leq A \leq 133$ mass region is given in terms of the simple dynamic collective model. In particular it is shown that the width of the GDR increases as β increases and as E_{2+} decreases and that the theoretically predicted spreading of the dipole strength is confirmed by our experimental results. As to the characteristic behavior of the GDR above its peak value at E_0, the conclusion is reached that the actual state of the art in (γ,xn) research does not allow one to make an unambiguous choice between isospin splitting or electric quadrupole absorption. Finally the numerical evaluations of the different sum rules are given and some empirical results concerning the average energy of the GDR as a function of A are also presented. (auth)

19713 ^{133m}Ba AND ^{133}Ba ISOTOPIC YIELDS AND ISOMER RATIOS IN ^{133}Cs(p,n) ^{133m,g}Ba AND ^{133}Cs(d,2n) ^{133m,g}Ba NUCLEAR REACTIONS. Dmitriev, P. P.; Molin, G. A.; Panarin, M. V. At. Energ. (USSR); 35: No. 1, 61-62(Jul 1973). (In Russian).

The yields of ^{133m}Ba and ^{133}Ba were measured as a function of the energy of the bombarding particle on irradiating thick cesium (CsCl or $CsNO_3$) targets with protons and deuterons. The ^{133m}Ba activity was determined from the 276-keV gamma ray peak at an assumed yield of 0.17 quantum per decay. In a similar fashion the ^{133}Ba yield was determined from the (356 + 382)-keV gamma at a total assumed yield of 0.77 quantum per decay. The ^{133}Ba activity was measured one month after irradiation with the use of radiochemical separation of the ^{133}Ba. The following yields were obtained: 980 microcuries/microamp · hr for ^{133m}Ba and 0.85 microcuries/microamp · hr for ^{133}Ba. Isomeric ratio was calculated for the above reactions as a function of proton and deuteron energy. (SJR)

19714 NUCLEAR STRUCTURE PARAMETER AND PERCENTAGE E2 ADMIXTURE FOR THE 57.60 keV TRANSITION IN ^{127}I. Venkata Ramaniah, K.; Seshi Reddy, T.; Venkata Reddy, K. (Andhra Univ., Waltair, India). Curr. Sci. (India); 43: No. 2, 41-42(20 Jan 1974).

The effect arising from the penetration of the atomic electrons into the nuclear volume introduces new matrix elements into the conversion electron ejection different from those due to gamma emission. In certain conditions, then, factors dependent on nuclear structure will appear in the internal conversion process, and structure effects should be especially large for l-forbidden M1 transitions. The diagram of penetration parameter vs E2 admixture for the 57.6-keV transition is shown. The results indicate a multipolarity for the transition of 99.42% M1 + 0.58% E2. (1 figure, 1 table) (RWR)

19715 SEMI-EMPIRICAL FORMULA FOR THE NEUTRON TOTAL CROSS SECTION AND THE INTERPRETATION OF THE EMPIRICAL FORMULA FOR $A \geq 40$. Ahmad, I.; Bano, N.; Saharia, A. N. (Aligarh Muslim Univ., India). Pramana; 1: No. 4, 188-195(Oct 1973).

Weaknesses in Angeli and Csikai's interpretation of their empirical formula for the neutron total cross section (σ_T) are pointed out. By using the Fourier–Bessel representation of the scattering amplitude, a semiempirical formula for σ_T is obtained which has greater applicability and also explains the success of the empirical formula for mass number $A \geq 40$ in terms of the

established trends in neutron optical potential parameters. (2 figures) (auth)

19716 COMPOUND CONTRIBUTION TO THE RADIATIVE WIDTH OF THE GROUND-STATE ANALOG IN ^{90}Zr. Rauch, F.; Seim, B. (Univ., Frankfurt am Main). Phys. Lett.; 48B: No. 1, 33-35(7 Jan 1974).

E1 transitions from the ground-state analog in ^{90}Zr to three 2^+ states are observed in the reaction ^{89}Y(p,γ)^{90}Zr. The transition strengths can be attributed mainly to a compound contribution to the radiative width of the analog state. (auth)

19717 SENSITIVITY OF THE FORWARD CROSS SECTION IN TRANSFER REACTIONS BETWEEN HEAVY IONS TO THE EDGE OF THE NUCLEAR FIELD. Ascuitto, R. J. (Yale Univ., New Haven); Glendenning, N. K. Phys. Lett.; 48B: No. 1, 6-8 (7 Jan 1974).

The ratio of the cross section for two nucleon transfer in heavy ion reactions measured at forward angle and at the grazing angle depends very sensitively on the location of the edge of the imaginary potential compared to the real. (auth)

19718 FINE AND INTERMEDIATE STRUCTURE IN THE ^{92}Zr(p,α)^{89}Y CROSS SECTION NEAR AN ISOBARIC ANALOG RESONANCE. Marquardt, N. (Univ. of Montreal); Poutissou, J. M.; Richter, A.; Tepel, J. W. Phys. Lett.; 48B: No. 1, 9-12 (7 Jan 1974).

Excitation functions for transitions to the ground and first two excited states of ^{89}Y were measured near the lowest $s_{\frac{1}{2}}$ isobaric analog resonance in ^{93}Nb in the singly isospin-forbidden reaction (ΔT = 1)^{92}Zr(p,α)^{89}Y. The data are analyzed in terms of a compound-nucleus model. (auth)

19719 SEMI-PHENOMENOLOGICAL DESCRIPTION OF THE GIANT DIPOLE RESONANCE WIDTH. Carlos, P.; Bergere, R.; Beil, H.; Lepretre, A.; Veyssiere, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A219: No. 1, 61-78(1974).

A set of experimental data, obtained by means of a monochromatic photon beam, is presented, which shows the evolution of the width of the giant dipole resonance Γ as a function of A. In particular, the correlation between the experimental GDR width Γ and the low energy characteristics β and E_{2^+} for Mo, Sn, Nd, and Sm isotopes is discussed in some detail. In the simplest case, one can express the photoabsorption cross section as a Breit-Wigner curve having a width $\Gamma\downarrow$ and it is also shown that one can write the empirical expression $\Gamma\downarrow = 0.026\ E^{1.90}$ where E is the mean dipole energy. According to the general concepts of the dynamic collective model, a semi-empirical formula capable of reproducing the general behaviour of Γ as a function of E, β and E_{2^+} is proposed for doubly even quasi-vibrational nuclei in the 96 < A < 150 mass region. (auth)

19720 LEVELS AND TRANSITIONS IN ^{131}Xe STUDIED BY THE DECAY OF ORIENTED ^{131}I. Koene, B. K. S.; Postma, H. (Univ., Groingen, Netherlands). Nucl. Phys.; A219: No. 3, 563-572(1974).

Sources of ^{131}I were prepared by implantation in iron foils. Nuclear orientation of these sources was obtained by cooling them to temperatures of 30 to 50 mK using a dilution refrigerator and saturating the iron by an external magnetic field. Anisotropies of angular distributions of eleven γ-transitions in ^{131}Xe were measured, yielding the following results: the levels at 405 and 637 keV are $\frac{3}{2}^+$ and $\frac{7}{2}^+$ states and the assignment $\frac{5}{2}^+$ for the level at 723 keV is confirmed. Deduced values of E2/M1 multipole mixing ratios are (energies in keV): $-0.5 \leq \delta(318) \leq +0.2$; $\delta(364) = -4.53 \pm 0.12$; $+0.2 \leq \delta(405) \leq +2.0$; $\delta(723) = +0.207 \pm 0.005$. The allowed β-decay branch to the level at 637 keV is for at least 90% of the Gamow–Teller type.

19721 ANGULAR CORRELATION STUDIES IN ^{144}Nd. Behar, M. (Purdue Univ., Lafayette, IN); Grabowski, Z. W.; Raman, S. Nucl. Phys.; A219: No. 3, 516-524(1974).

The decays of ^{144}Pr and ^{144}Pm populate ten excited states in ^{144}Nd. Detailed $\gamma\gamma$ angular correlation measurements were carried out in order to establish spin assignments for the levels. The measurements were performed with Ge(Li)-Ge(Li) and NaI(Tl)-Ge(Li) systems. Eleven sets of A_{22} and A_{44} values were obtained. The J^π assignments for levels in ^{144}Nd (level energies in keV) are as follows: g.s., 0^+; 696, 2^+; 1314, 4^+; 1511, 3^-; 1561, 2^+; 1791, 6^+; 2084, 2^+; 2093, 5^-; 2186, 1^-; 2204, 4; 2644, 1. Mixing ratios were determined for six γ-transitions.

19722 EXPERIMENTAL DETERMINATION OF THE ELECTRON DENSITY AT THE NUCLEUS AS A FUNCTION OF THE CHEMICAL STATE OF RUTHENIUM. Hofmann-Reinecke, H.; Zahn, U.; Daniel, H. (Technische Univ., Munich). Phys. Lett.; 47B: No. 6, 494-496(24 Dec 1973).

The effect of the chemical state on the electron capture rate was measured for the first time at an element suitable for Moessbauer work (Ru). Changes of the electron densities at the nucleus are deduced with (as well as without) overlap and exchange corrections. (auth)

19723 INELASTIC SCATTERING OF NEUTRONS ON EVEN-EVEN ISOTOPES OF Cd, Sn, AND Te IN THE ENERGY RANGE NEAR THRESHOLD. Konobeevskii, E. S.; Musaelyan, R. M.; Popov, V. I.; Surkova, I. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1900-1903(Sep 1973). (In Russian).

For the purpose of searching for deviations from the statistical model, measurements were made of the inelastic scattering cross sections for neutrons close to the threshold for the excitation of the first 2^+ levels of Cd, Sn, and Te in the neutron energy range from 400 to 500 keV above the threshold for the excitation of the energy levels with energy resolution of 10 to 15 keV. The analysis of the results obtained showed that the dependence of the mean cross section on the energy can be satisfactorily described by the statistical theory under the assumption of uncorrelated widths with use of the optical potential which gives for p-neutron strength functions values not in contradiction with known experimental data. (2 figures) (tr-auth)

19724 STUDY OF THE EXCITATION FUNCTION OF THE Mo + d REACTION. Aleksandrov, Yu. A.; Aprelev, M. V.; Zarubin, P. P.; Padalko, V. Yu.; Podkopaev, Yu. N.; Sergienko, V. A.; Khrisanfov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1885-1889(Sep 1973). (In Russian).

The excitation function for the ^{92}Mo(d,n)^{93}Tc,^{93}Tc reaction was studied. The energy dependence of the isomer ratio was determined. A comparison of the experimental and theoretical data was made. (5 figures) (tr-auth)

19725 ANGULAR DISTRIBUTION OF PROTONS ELASTICALLY SCATTERED ON Pd, Cd, AND Sn ISOTOPES IN THE NONRESONANCE ENERGY REGION AND ITS OPTICAL-MODEL DESCRIPTION. Guzhovskii, B. Ya.; Abramovich, S. N.; Dzyuba, B. M.; Zvenigorodskii, A. G.; Podval'nyi, V. G.; Trusillo, S. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1880-1884(Sep 1973). (In Russian).

Measurements were made on the tandem accelerator of the ratio $\sigma_{elas}\ (\theta)/\sigma_{Coul}(\theta)$ with an error of $\pm 1\%$ in the interval θ = 30 to 165° on the target nuclei $^{104, 106, 108, 110}$Pd, $^{110, 112, 114, 116}$Cd, and $^{118, 120, 122, 124}$Sn at proton energies from 5.5 to 7.5 MeV, that is, in the region below the first isobaric-analog resonance. (1 figure, 4 tables) (tr-auth)

19726 INVESTIGATION OF THE INTERNAL CONVERSION ELECTRON SPECTRUM OF ^{146}Gd. Gavrilyuk, V. I.; Gromov, K. Ya.; Klyuchnikov, A. A.; Kupryashkin, V. T.; Latyshev, G. D.; Makovetskii, Yu. V.; Feoktistov, A. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1839-1845(Sep 1973). (In Russian).

The internal conversion electron spectrum of ^{146}Gd was measured very precisely to determine the intensity of the conversion lines of the L subshell, to investigate a possible decay scheme, and to detect K421 and K576 transitions. The decay scheme of ^{146}Eu is given. (2 figures, 3 tables) (JSR)

19727 LEVEL SCHEME OF ^{130}Te, EXCITED BY THE β DECAY ^{130}Sb ($T_{\frac{1}{2}}$ = 40 min). Kerek, A.; Carle, P.; McDonald, J. (Inst. of Physical Research, Stockholm). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1822-1823(Sep 1973). (In Russian).

The γ and conversion electron spectra of ^{130}Sb were measured with Ge(Li) and Si(Li) detectors, and the level scheme of ^{130}Te was determined from these data. (1 figure) (JSR)

19728 STUDY OF THE LEVELS OF ^{137}Ba AND ^{138}Ba EXCITED IN (α,xn) REACTIONS ON ^{136}Xe. Kerek, A.; Kovnatski, I. (Inst. of Physical Research, Stockholm). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1824-1826(Sep 1973). (In Russian).

The γ spectrum, angular distributions, and $\gamma-\gamma$ coincidence spectrum from (α,xn) reactions on ^{136}Xe at bombarding energies of 20, 23, 26, and 29 MeV were measured. The energy levels of ^{137}Ba and ^{138}Ba were obtained from these data. The experimental energy levels of ^{138}Ba were compared with levels calculated using a δ-function force. The possible structure of the energy levels of ^{137}Ba was given. (4 figures) (JSR)

19729 NUCLEAR LEVEL SCHEMES A = 45 THROUGH A = 257 FROM NUCLEAR DATA SHEETS. New York; Academic Press, Inc. (1973). 510p. $23.50.

This collection assembles the level schemes for A > 44 from the Nuclear Data Sheets. Although this volume was mainly prepared by photocopying the drawings contained in past issues of the Nuclear Data Sheets, the editors made corrections in a few cases where gross errors were known. As the drawings were prepared for use with the summary and data sheets, they are not self-contained. (RWR)

19730 HYPERFINE STRUCTURE OF THE 5^3P_1 STATE OF $^{115}Cd^m$. Geelhood, B. D.; McDermott, M. N. (Univ. of Washington, Seattle). Phys. Lett.; 46A: No. 3, 211-212(17 Dec 1973).

The magnetic fields at which Zeeman sublevels cross in the excited 5^3P_1 state of the 43-day isomer ^{115m}Cd were determined for three pairs of levels. The crossing fields are used to determine the magnetic dipole hyperfine structure constant $A(^3P_1) = -656.491$ (4) MHz and the quadrupole constant $B(^3P_1) = 129.39$ (6) MHz. (auth)

19731 STATISTICAL ANALYSIS OF γ-RAY ANGULAR CORRELATION EXPERIMENTS. James, A. N.; Twin, P. J.; Butler, P. A. (Univ. of Liverpool). Nucl. Instrum. Methods; 115: No. 1, 105-113(1974).

The statistical analysis of γ-ray angular correlation experiments is discussed with the emphasis on experiments where the reaction mechanism does not lead to exactly known alignment. If a model of the reaction producing the alignment is made, then it can be used to estimate the most probable value of the alignment and the confidence in that prediction. The inclusion of such estimates in the analysis is described. A procedure for including many types of relevant data into the analysis is described. Particular emphasis is given to the general technique of estimating the error to quote in association with a mixing ratio measurement. A cautious recipe for the estimate is suggested which follows the procedures of linear least-squares regression analysis. (6 figures, 3 tables) (auth)

19732 TWO-PARAMETER DESCRIPTIONS OF NUCLEAR ROTATIONAL ENERGIES. Haapakoski, P. (Univ. of Helsinki); Holmberg, P.; Lipas, P. O. Phys. Fenn.; 8: No. 1, 33-42(May 1973).

Several two-parameter descriptions of ground band energies in even nuclei are discussed. Eight cases are tested on ^{100}Pd, ^{124}Xe, ^{152}Gd, ^{152}Sm, ^{162}Er, ^{170}Hf, ^{194}Pt and ^{238}U. The multiplicity of possible descriptions derived from systematics or phenomenology undermines their value vis-a-vis a more fundamental theory. (auth)

19733 SHELL-MODEL ANALYSIS OF HELION AND TRITON INELASTIC SCATTERING FROM ^{90}Zr INCLUDING CORE POLARIZATION EFFECTS. Park, J. Y. (North Carolina State Univ., Raleigh). Z. Phys.; 264: No. 5, 355-378(1973).

A microscopic analysis of the inelastic scattering of helions and tritons from ^{90}Zr is performed using the shell-model wave functions and phenomenological effective interactions. Effects of the core polarization are studied assuming a collective model for the core of closed shells. Core coupling parameters A(L) are obtained from the measured electromagnetic transition rate, B(EL). For those transitions for which no measured B(EL) values are available, A(L) values which fit the data were extracted. The radial forms of both the Gaussian and Yukawa interactions were studied. Effects of the non-locality of the bound states on the predicted cross sections are found to be small. As in the case of proton inelastic scattering, it is found that the valence (direct) contributions are small and the transitions are dominated by core polarization. The strength of the effective interaction required to fit the data is reduced by a factor of two or more when the core polarization contributions are included. (GE)

19734 EXCITATION FUNCTIONS AND α-DECAY FROM COMPOUND NUCLEI IN Ar INDUCED REACTIONS ON ^{144}Sm AND ^{166}Er. Gauvin, H.; Hahn, R. L.; Lagarde, B.; Le Beyec, Y.; Lefort, M. (Institut Physique Nucleaire, Orsay, France). Nucl. Phys.; A220: No. 1, 84-92(1974).

Excitation functions for the reactions $^{40}Ar + {}^{144}Sm \rightarrow$ Pt and $^{40}Ar + {}^{166}Er \rightarrow$ Po radionuclides, in which the observed nuclei have two protons less than the product of the complete fusion of projectile and target, were found to be characterized by two peaks. Independent of whether the target was Sm or Er, and independent of the mass of the product, the two peaks were consistently found to be separated by $\approx$ 40 MeV of excitation energy. Consideration of other experiments with ^{40}Ar ions, and with lighter projectiles, leads one to the conclusion that the two peaks are due to different compound-nuclear de-excitation processes: the first peak involves the evaporation of an α-particle, (Ar, α(x-2)n), and the second peak, the emission of nucleons only, (Ar, 2pxn). (auth)

19735 FISSION OF MEDIUM AND HEAVY NUCLEI INDUCED BY ^{40}Ar FROM 160 TO 300 MeV: AVERAGE TOTAL KINETIC ENERGY. Borderie, B.; Hanappe, F.; Ngo, C.; Peter, J.; Tamain, B. (Chimie Nucleaire, IPN, Orsay, France). Nucl. Phys.; A220: No. 1, 93-102(1974).

The average total kinetic energy of fission fragments for symmetric fission induced by argon ions was measured over a wide range of fissility parameters. The results are compared with other results, with the predictions of Nix (liquid-drop model) and those of Mosel and Schmitt (two-center model). The shell effects predicted by Mosel and Schmitt are not seen, probably because of the high value of the excitation energies involved in the reactions. The variation of the total kinetic energy with the fissility parameter is rather well described by Nix but the calculated absolute values are too low. It seems that the fissility parameter (used in the liquid-drop model) rather than the mass of the fissioning nucleus (in the Mosel and Schmitt model), is the important parameter which determines the total fragment kinetic energy of excited nuclei. (auth)

19736 CHARGE-EXCHANGE REACTIONS ON ^{91}Zr. Ingalls, P. D.; Rudolph, H. (Univ. of Colorado, Boulder). Nucl. Phys.; A220: No. 1, 191-197(1974).

The $^{91}Zr(\tau,t)^{91}Nb$(IAS) reaction and subsequent proton decay were studied at 24.5 MeV bombarding energy. Singles and coincidence decay proton spectra were measured, giving yields in agreement with the yield computed from the triton angular distribution. The singles $(\tau,t\tilde{p})$ proton spectrum from 24.5 MeV helion bombardment is compared to the singles $(p,n\tilde{p})$ proton spectrum from a 27 MeV proton bombardment. These spectra contain significant structure in the distribution of "background" protons (usually assumed structureless). (auth)

19737 β-MOMENTS FOR THE $\frac{7}{2}^-$(3.63 MeV β^-)$\frac{5}{2}^+$ TRANSITION FROM ^{137}Xe AND THE FIRST-FORBIDDEN β^- DECAY OF ODD-MASS N = 83 NUCLIDES. Szybisz, L. (Kernforschungszentrums, Karlsruhe, Ger.). Nucl. Phys.; A220: No. 1, 173-182(1974).

The β-moments of the $\frac{7}{2}^-(\beta^-)\frac{5}{2}^+$ transition in the decay of ^{137}Xe were extracted from the available experimental data. The results (in fm) are: $\langle ir\rangle = 2.08 \pm 0.68$; $\langle \sigma \times r\rangle = -2.05 \pm 0.45$; $\langle iB_{ij}\rangle = 4.01 \pm 1.41$; $\xi^{-1}\langle\alpha\rangle = 4.96^{+0.5}_{-0.7}$. These values show that the β-moment ratio Λ (= $\langle\alpha\rangle/\xi\langle ir\rangle$) agrees with theoretical estimates both by Fujita-Eichler and Damgaard-Winther, and that the β-moments are reduced with respect to a conventional pairing model. The present results are compared with those of similar studies. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 19653, 19693, 19709, 19710, 19719, 19729, 19732, 19735, and 19838.

19738 (AECL-4657, p 20) LIFETIMES IN THE GROUND STATE BAND OF ^{184}Hg. Rud, N.; Ward, D.; Andrews, H. R.; Graham, R. L.; Geiger, J. S. Oct 1973.

19739 (COO-1779-128) ANNUAL REPORT, JULY 1, 1972–JULY 1, 1973. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Oct 1973. 170p. Dep. NTIS $10.50.

This report is divided into five sections: Research in progress, Abstracts of talks at meetings, Title page of published papers, Abstracts of papers in press, and Ph. D. thesis titles. The research reports are fairly brief, usually a page or so in length. They cover both nuclear physics and cyclotron operation and instrumentation. Those reports with significant amounts of data are title listed separately. (RWR)

For title listings of individual papers see: 19619–19621, 19650–19652, 19670–19674, 19685, 19698–19701, 19740–19745, 19760, and 19761.

19740 (COO-1779-128, p 42) $^{154}Sm(\alpha,{}^6He)^{152}Sm$ REACTION. Boyno, J. S.; Benenson, W.; Khoo, T. L.; McHarris, W. C.; Warner, R. A. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19741 (COO-1779-128, pp 59-61) DECAY OF ^{177}Ta TO LEVELS OF ^{177}Hf. Jeltema, B. D.; Bernthal, F. M. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19742 (COO-1779-128, pp 65-67) EXPERIMENTAL DEMONSTRATION OF BACKBENDING FROM A BAND-CROSSING IN ^{154}Gd. Khoo, T. L.; Bernthal, F. M.; Boyno, J. S.; Warner, R. A. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19743 (COO-1779-128, pp 68-69) BACKBENDING IN Os ISOTOPES. Warner, R. A.; Bernthal, F. M.; Boyno, J. S.; Khoo, T. L.; Sletten, G.; Jeltema, B. D. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19744 (COO-1779-128, pp 70-71) BACKBENDING AND FORKING IN ^{182}W. Jeltema, B. D.; Bernthal, F. M. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19745 (COO-1779-128, p 73) ROTATIONAL BANDS IN ^{182}Re. Slaughter, M.; Warner, R. A.; Kelly, W. H.; McHarris, W. C. Oct 1973.

In annual report, July 1 1972–July 1, 1973.

19746 (JINR-P4-7517) STATES WITH $K^{\pi} = 1^+$ AND THEIR CONTRIBUTION TO THE ISOSCALAR E2-RESONANCE. Kuliev, A. A.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

The RPA method of restoration of the rotational invariance for deformed self-consistent field was used to obtain a consistent description of both the rotational branch of excitation and the intrinsic states with $K^{\pi} = 1^+$. The method reproduces all the cranking-model results for the rotational states but in addition to that it allows one to connect the characteristics of the effective isoscalar quadrupole-like interactions with the angular momentum matrix elements of the deformed field. Hence, the equation for the energy of 1^+ excitations involves no additional parameters besides those for the deformed field. The static effective charges for E2-transitions with $\Delta K = 1$ are determined from the contribution of the ground band rotational 2^+ state to the energy-weighted sum rule, and they are found to be of the order $e^{(p)} \sim 1.1 - 1.2$ and $e^{(n)} \sim 0.1 - 0.2$. From calculations of the energy-weighted sum rule for E2-transitions it is found that in the rare-earth nuclei E2-transitions with $\Delta K = 1$ exhaust about 70% of the model-independent estimate $S_{E2,T=0}$, the rest being shared among 2^+ states with $K = 0$ and 2. The rotational 2^+ state contains less than a half of the total strength of E2 ($\Delta K = 1$) transitions without change of the principal quantum number ($\Delta N = 0$). The rest of this strength is shared among 1^+ excitations in the energy region 2 to 6 MeV, and it gives rise to the dynamic effective charges for E2 ($\Delta K = 1$) transitions in odd-mass nuclei. The E2 ($\Delta K = 1$) transitions with $\Delta N = 2$ give the main contribution to the sum rule. The calculated strength function for E2 transitions shows a maximum located in the energy region 12.5 to 14 MeV, which represents the $K = 1$ part of the isoscalar E2 resonance. The 1^+ states in this region exhaust about 15 to 20% of $S_{E2,T=0}$. The isovector spin–spin forces were included in calculations. The calculated strength function for M1 transitions shows a maximum in the energy region 7 to 9 MeV, where the M1-resonance is expected to occur. (auth)

19747 (MNC-4028-12, pp 54-57) ALPHA DECAY OF NATURAL ^{186}Os. Jackson, S. V.; Walters, W. B. 1 Nov 1973.

In research in nuclear chemistry.

19748 HALF-LIFE OF THE 482 keV LEVEL OF ^{181}Ta. Lowe, L. M.; Zmore, H.; Prestwich, W. V. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 14, 1497-1498(15 Jul 1973).

A delayed coincidence measurement of the half-life of the 482 keV level of ^{181}Ta was performed. In the analysis, careful attention was directed towards system nonlinearities and an accurate method of TAC calibration. The result is $T_{1/2} = 10.81 \pm 0.05$ ns. (auth)

19749 KNOCK-ON MECHANISM FOR (n,α) REACTIONS INDUCED BY FAST NEUTRONS ON THE DEFORMED ODD–EVEN NUCLEI. Glowacka, L.; Jaskola, M.; Kozlowski, M.; Osakiewicz, W.; Turkiewicz, J.; Zemlo, L. (Inst. of Nuclear Research, Warsaw). Can. J. Phys.; 51: No. 16, 1765-1769(15 Aug 1973).

A method for the calculation of the energy spectra of α particles from (n,α) reactions on deformed odd–even nuclei is developed. The resulting energy spectra for 14 MeV (n,α) reactions in ^{153}Eu, ^{159}Tb, and ^{169}Tm are compared with experimental data. Agreement reached suggests the dominance of the knock-on mechanism in the investigated reactions. (auth)

19750 ROTATIONAL BANDS IN ^{171}Lu. Gregory, P. R.; Preibisz, Z.; Waddington, J. C.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 51: No. 16, 1715-1736(15 Aug 1973).

A variety of experiments was performed in order to establish and identify the states in the rare earth deformed nucleus ^{171}Lu. Proton particle states were studied using (^{3}He,d) and (α,t) stripping reactions. The reaction products were analyzed with an "Enge" split-pole magnetic spectrograph. The expected components of the following intrinsic proton states were identified: $1/2^+[404]$ (ground state), $1/2^-[541]$, $1/2^+[411]$, $1/2^+[402]$, and $1/2^-[514]$. In addition, tentative assignments are made for rotational states based on the $3/2^-[532]$, $1/2^-[530]$, and $1/2^+[660]$ orbitals, and for states which are mixtures of β and γ vibrations and particle states. The cross section ratios of the two stripping reactions were used as an indication of l value and spectroscopic factors were extracted using DWBA calculations. Gamma radiation and conversion electrons following the reaction ^{169}Tm(α,2n)^{171}Lu were studied, using high resolution Ge(Li) detectors in singles and coincidence mode, and an on-line, double-focusing, electron spectrometer. Coincidence probabilities were calculated and were used to determine the intensities of unresolved gamma transitions. Excitation functions of gamma rays following the ^{165}Er(^{7}Li,xn) reaction were used to check isotopic assignments. The ratio of the relative intensities of gamma transitions following the ^{7}Li and ^{4}He induced reactions was found to be a good indicator of the spin of the deexciting level. A level scheme is proposed which includes a number of K-forbidden interband transitions. (auth)

19751 CHOICE OF THE CONSTRAINING OPERATOR IN THE CONSTRAINED HARTREE–FOCK METHOD. Holzwarth, G.; Yukawa, T. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; A219: No. 1, 125-140(1974).

The variation of the generator coordinate trial function with respect to the path of integration leads to a prescription for the choice of the constraining operator in constrained Hartree–Fock calculations. The resulting path follows a local valley in the deformation energy surface. The proposed scheme is applied to a three-level model with SU(3) symmetry. (auth)

19752 HIGH SPIN STATES IN THE GROUND AND β-BANDS OF ^{156}Dy AND THE BAND-CROSSING INTERPRETATION OF BACK BENDING. Andrews, H. R.; Ward, D.; Graham, R. L.; Geiger, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Phys.; A219: No. 1, 141-156(1974).

High spin states were identified in ^{156}Dy using (HI,xn) reactions and γ–γ coincidence techniques. The ground state band does not show any "phase change" or "back bending" behaviour up to spin 18^+. However a second sequence, based on the β-vibrational band, does show back bending at spin 12^+. The two sequences intersect just below spin 16^+ with the 16^+, 18^+ and 20^+ members of the β-band sequence becoming yrast levels. Branching ratios were obtained for transitions above and below the bend at spin 12^+. The data are discussed in terms of a simple band-crossing model of back bending. (auth)

19753 NOTE ON THE SPIN DEPENDENCE OF M1 ADMIXTURES IN TRANSITIONS FROM BETA AND GAMMA VIBRATIONAL STATES IN ^{154}Gd. Collins, W. E. (Southern Univ., Baton Rouge, LA); Hamilton, J. H. Particles Nucl.; 6: No. 2-3, 82-85(1973).

The M1 admixtures in the $4_\beta \rightarrow 4_g$ and $4_\gamma \rightarrow 4_g$ in ^{154}Gd were measured via γ–γ directional correlations with a Na-Ge(Li) detector system. For the 676 keV, $4_\beta \rightarrow 4_g$ transition the data yield $\delta = 2.6 \pm 0.5$ and for the 893-keV, $4_\gamma \rightarrow 4_g$ transition $\delta = -(4.2 \pm {}^{2.0}_{1.5})$. (auth)

19754 INVESTIGATION OF THE γ–γ COINCIDENCES IN THE ^{178}Hf(n,γ)^{179}Hf REACTION. Beitin, M. R.; Prade, Kh. (Inst. of Physics, Riga). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1813-1817(Sep 1973). (In Russian).

The γ spectrum and the γ–γ coincidence spectrum were measured with a Ge(Li) detector. Four new levels were detected with energies of 989.9, 1185.5, 1250.6, and 1280.3 keV. The spin and parity $3/2^+$ were proposed for the level with energy of 1185.5 keV, and its nature was discussed. (1 figure, 2 tables) (tr-auth)

19755 COULOMB EXCITATION STUDIES OF ^{160}Dy, ^{162}Dy, AND ^{164}Dy. Oehlberg, R. N.; Riedinger, L. L.; Rainis, A. E.; Schmidt, A. G.; Funk, E. G.; Mihelich, J. W. (Univ. of Notre Dame, IN). Nucl. Phys.; A219: No. 3, 543-562(1974).

Coulomb excitation measurements with ^{16}O and ^{4}He projectiles were performed on ^{160}Dy, ^{162}Dy, and ^{164}Dy. The ground-state rotational bands up through the 8^+ member were observed in the ^{16}O experiments. The measured excitation probabilities yield B(E2; $I \rightarrow I-2$) values which are generally in agreement with the rotational predictions except for the $6^+ \rightarrow 4^+$ values. In each nucleus, probabilities for exciting the 2^+, 4^+, and 6^+ members of the γ-vibrational band were measured and compared with calculated results. The B(E2; $0^+ \rightarrow 2^+\gamma$) values were measured in experiments involving ^{4}He ions. The $K^{\pi} = 2^-$ octupole band was observed in each nucleus in addition to 1^- bands in ^{160}Dy and ^{162}Dy. Excitation probabilities were analyzed in an attempt to extract B(E3) values. (auth)

19756 PROBABILITY OF E2 TRANSITIONS BETWEEN LEVELS OF THE GROUND-STATE BAND OF ^{158}Er IN THE CRITICAL SPIN REGION (10^+ TO 18^+). Andrews, G. R. (Chalk River Nuclear Lab., Ont.); Ward, D.; Graham, R. L.; Geiger, J.; Sharpey-Shafer, J. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1791-1795(Sep 1973). (In Russian).

The lifetimes of the high-spin states of the ground-state rotational band of ^{158}Er and the transition probabilities were measured, and the results are tabulated. The change of the ratio of the intensity of the γ radiation as a function of the distance traversed by the recoil atoms is shown for the $18^+ \rightarrow 16^+$, $16^+ \rightarrow 14^+$, and $12^+ \rightarrow 10^+$ transitions. The measured value of B(E2) is compared with the value calculated from the rotational model. (4 figures, 1 table) (JSR)

19757 INVESTIGATION OF PERTURBED ANGULAR CORRELATIONS OF ^{181}Ta IN Hf–Ni ALLOY. Kryukova, L. N.; Ryasnyi, G. K.; Sorokin, A. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1818-1821(Sep 1973). (In Russian).

With ^{181}Hf sources in the form of alloy with 0.3 at. % Ni, prepared by the arc fusion method, measurements were made of the perturbed $\gamma-\gamma$ angular correlation. From the differential measurement of the 133–482-keV cascade in Ta nuclei $H_{ef} = 91 \pm 2$ kG was obtained in agreement with known data. The parameters of the experimental curves showed that ~45% of the Hf atoms in this source exist at lattice points in the matrix, which is close to the value obtainable with sources prepared by the implantation method. Probably significantly smaller (or zero) fields act on the nucleus of the atom found at the lattice sites. (3 figures) (tr-auth)

19758 FINITE-RANGE CALCULATION OF TWO-NEUTRON TRANSFER REACTIONS ON RARE-EARTH NUCLEI. Takemasa, T. (Osaka Univ., Toyonaka, Japan). Nucl. Phys.; A220: No. 1, 31-44(1974).

Finite-range DWBA calculations were done for (p,t) reactions on rare-earth nuclei. The perturbation interaction acting between the proton and each transferred neutron was assumed to have a Gaussian shape. At low incident energy, very good agreement with the zero-range calculation was found both in the shapes of the angular distributions and in the magnitudes of the cross sections for the 2^+ and 4^+ ground-band members relative to the ground-state transition. At high incident energy, however, the finite-range calculations produced considerable changes in the shapes of the angular distributions. The better agreement with the experimental data indicates the importance of the finite-range interaction at high incident energies. It was also found that the errors introduced by assuming a transferred pair to be in a relative s-state have surprisingly little effect on the shapes and the magnitudes of the cross sections. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 19620, 19649, 19653, 19663, 19691, 19692, 19705, 19729, 19739, 19778, and 19798.

19759 (AECL-4657, pp 18-19) G-FACTOR OF THE H_{11}^{8+} ISOMERIC STATE IN ^{212}Rn. Witthuhn, W.; Haeusser, O.; McDonald, A. B.; Fossan, D. B.; Olin, A. Oct 1973.

19760 (COO-1779-128, pp 20-21) HIGH RESOLUTION STUDY OF THE Pb AND Bi ISOTOPES. Wagner, W. T.; Crawley, G. M. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19761 (COO-1779-128, pp 32-33) ^{206}Pb(p,d)^{205}Pb REACTION. Lanford, W. A. Oct 1973.

In annual report, July 1, 1972–July 1, 1973.

19762 (MNC-4028-12, pp 5-12) FISSION-FRAGMENT ANGULAR DISTRIBUTIONS FROM INTERMEDIATE-ENERGY ^{4}He-ION-INDUCED REACTIONS. Viola, V. E. Jr.; Roche, C. T.; Meyer, W. G.; Clark, R. G. 1 Nov 1973.

In research in nuclear chemistry.

19763 (MNC-4028-12, pp 15-21) LINEAR MOMENTUM TRANSFER IN REACTIONS OF 140-MeV ^{4}He IONS WITH HEAVY ELEMENTS. Meyer, W. G.; Minor, M. M.; Roche, C. T.; Viola, V. E. Jr. 1 Nov 1973.

In research in nuclear chemistry.

19764 INFLUENCE OF THE QUADRUPOLE-PAIRING INTERACTION ON THE $J^\pi = 0^+$ VIBRATIONS IN THE Pt REGION. Zielinska-Pfabe, M. (Technische Univ., Munich/Garching, Ger.); Stepien-Rudzka, W. Z. Phys.; 264: No. 5, 399-404(1973).

The dependence of the energy of the lowest pairing-vibrational state on the quadrupole-pairing strength G_2 is investigated in the Pt isotopes. The calculations are made using the random phase approximation for the collective states with the pairing forces treated in the BCS approximation. (GE)

19765 PROTON AND NEUTRON RADII OF ^{208}Pb FROM TRANSFER REACTIONS AND SINGLE PARTICLE ENERGIES. Dost, M. (CEN de Saclay, Gif-sur-Yvette, France); Doubre, H.; Royer, D. Z. Phys.; 265: No. 4, 371-383(Nov 1973).

Neutron and proton transfer cross sections and single-particle energies are converted into rms radii of density distributions via independent particle wave functions. The radii of the neutron excess and the analogous "proton excess" are found to be the same. Comparison is made with the results of other experiments. (GE)

19766 ELASTIC ELECTRON SCATTERING MUONIC X RAYS, AND THE CHARGE DISTRIBUTION OF ^{208}Pb. Friar, J. L.; Negele, J. W. Comments Nucl. Particle Phys.; 5: No. 6, 181-188(Nov 1972).

It is stated that until recently elastic electron scattering and muonic x-ray experiments were analyzed in a rather unsystematic way in terms of simple analytical parameterizations of nuclear charge distribution, and had little association with theoretical nuclear physics, but now that nuclear theory includes nuclear wave functions that agree closely with experimental findings such experiments have a far greater significance. Indeed, the known electromagnetic interaction between leptons and nuclei makes scattering and bound state experiments with electrons and muons unique probes of nuclear wave functions and an essential tool in the testing of nuclear theory. Two questions are discussed—how much information do present experiments give concerning nuclear charge density, subject to reasonable model assumptions, and are any features of the charge distribution specified by the data in conflict with present theory. Although the discussion is relevant to nuclei throughout the periodic table, attention is restricted to ^{208}Pb, for which experimental and theoretical information is most extensive. (UK)

19767 SPECTROSCOPIC STUDY OF ^{205}Tl BY 7646 keV NEUTRON CAPTURE GAMMA-RAYS. Oliva, P. R. (CNEN, Rome); Prosperi, D.; Alberini, R. Nuovo Cim.; 19A: No. 2, 294-308 (21 Jan 1974).

A monochromatic 7646 keV gamma-ray beam, produced by thermal-neutron capture in iron, resonantly excites a ^{205}Tl $\frac{1}{2}^-$ level. Primary inelastic photons suggest the existence of 20 levels between 203.8 and 3288.0 keV excitation energy. To complete the decay scheme, the spectrum of low-energy photons (≤3 MeV) has been studied by an anti-Compton spectrometer. About 60 gamma lines have been detected. By the energy and intensity balance six further levels have been added. The final decay scheme, constructed by 74 transitions, has been finally compared with theoretical predictions. (auth)

19768 POLARIZED MUONIC ATOMS. Nagamine, K.; Yamazaki, T. (Tokyo Univ.). Nucl. Phys.; A219: No. 1, 104-114 (1974).

A new type of muonic X-ray spectroscopy with use of polarized muons and polarized nuclear targets is proposed in order to determine precisely the magnetic hyperfine coupling constants in muonic atoms. The principle and formalism underlying the proposed experiments are presented together with numerical calculations for the case of the muonic ^{209}Bi atom. It is shown that the selective population of the sublevels designated by F of hf multiplets of $J = l - \frac{1}{2}$ does not depend on the hyperfine interactions during the preceding muonic cascades which may depolarize the muon spin. Strong polarization effects on the line profile of the $2p_{\frac{1}{2}} \rightarrow 1s_{\frac{1}{2}}$ transition are expected resulting from (a) the selective population of one F-state of the $2p_{\frac{1}{2}}$ level and (b) the residual orientation of the hf multiplet. These effects can be used to determine the coupling constants much more precisely than in unpolarized cases. (auth)

19769 GIANT E2 RESONANCE. Surprising Fine Structure and Missing Strength in ^{208}Pb. Hansen, O.; Nathan, O. (Niels Bohr Inst., Copenhagen). Comments Nucl. Particle Phys.; 5: No. 6, 165-169(Nov 1972).

It is stated that the giant resonances are built up of excitations that promote a nucleon from one single-particle orbit into another particle state and that they depend on the existence of an interaction that can order these single-particle jumps into a coherent motion. This leads to an attractive force for isoscalar modes, where protons and neutrons move in phase with one another, so that the interaction exploits the proton-neutron attraction. Reference is made to Satchler (Comm. Nucl. Part. Phys.; 5: 145(1972)), who discussed the predicted properties of the various giant resonances in nuclei in terms of the energy-weighted model-independent sum rule. Recent data on the (2,0,2) energies are surveyed; the gross trend is as expected, but the fine structure appears to contain surprises for the important case of ^{208}Pb, and it is not certain that the expected E2 oscillator strength can be traced in this nucleus in the energy region studied. Whereas the average energy of the (2,0,2) mode in spherical nuclei simply reflects the size of the nuclear system, details of the energy spectra appear to pose some very interesting nuclear structure problems, and a study of such energy details is a strong challenge to available inelastic scattering techniques, since an energy resolution of about 0.1% or better is called for in experiments in the ≈100 MeV region. At present it seems that only electron experiments can meet this challenge adequately, and further improvement in the direction of better energy resolution is called for with protons. With regard to fine structure details the most surprising results concern ^{208}Pb, where the 125 to 250 MeV electron data have revealed five strong giant quadrupole states in

the interval 9 to 11 MeV and a few weaker states in between. The question of the location and possible fine structure of the giant resonance in the region of strongly deformed nuclei is also very interesting, but as yet unexplored experimentally. (UK)

19770 DEFORMATION EFFECTS IN HEAVY-ION SCATTERING. Rowley, N. (Oxford Univ.). Nucl. Phys.; A219: No. 1, 93-103(1974).

Many experiments on the scattering of heavy ions confirm that the elastic cross sections display characteristics of Fresnel diffraction. Recent experiments on the scattering of very heavy ions, however, show marked deviations from the expected Fresnel shapes and an analysis of these experiments using the "quarter-point-recipe" of the Fresnel cross section yields a larger radius for ^{208}Pb than for ^{232}Th. It is shown that the deviations may be described in terms of the ground state deformations of the nuclei involved. Taking the deformations into account removes the above anomaly in the radii. The actual fit to the experimental cross sections is not very good and suggests that the real part of the nuclear potential may have an appreciable effect on the orbits of nuclei which are elastically scattered below the Coulomb barrier. (auth)

19771 SUMMARY DRAWING, A = 209-229. Maples, C. (Univ. of California, Berkeley). Nucl. Data, Sheets; 10: No. 6, 595(Dec 1973).

A drawing showing the major decay modes and branching (≥5%) in nuclei with A = 209 to 229 leading to ^{209}Bi is presented. (RWR)

19772 ^{203}Tl(n,γ) REACTION AND LEVEL STRUCTURE OF ^{204}Tl. Fubini, A. (CNEN, Rome); Alberini, R.; Lattanzi, D. Nuovo Cim.; 18A: No. 4, 711-725(21 Dec 1973).

The low-lying level structure of $^{204}_{81}$Tl was studied by means of the thermal-neutron capture reaction on ^{203}Tl. The γ-ray spectrum from this reaction was studied below 1.8 MeV with a Ge(Li) spectrometer. Owing to the great complexity of the decay scheme γ-γ coincidence measurements using two Ge(Li) detectors were made. Spin and parity assignments for some of the lowest-lying levels are proposed. The level energy values are 140.6, 300.0, 318.4, 432.3, 471.6, 488.2, 535.9, 628.3, 736.7, 1013.6, 1051.9, 1250.7, 1474.3 and 1741.1 keV. The agreement of the present results with a recent calculation of the low-energy spectra of odd-odd thallium isotopes seems satisfactory, at least for what concerns the first excited levels. (auth)

19773 DECAY SCHEME OF ^{197}Tl. Vandlik, T. B.; Vandlik, Ya.; Zaitseva, N. G.; Makhunka, L.; Makhunka, M.; Mate, Z.; Tyrroff, Kh.; Fenesh, T.; Fominykh, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1796-1803(Sep 1973). (In Russian).

The experimental installation and methods used for the measurement of the ^{197}Tl decay scheme are described. The results of the measurement of the γ spectrum, conversion electron spectrum, and γ-γ coincidences are tabulated. The decay scheme is given. (1 figure, 2 tables) (JSR)

19774 DECAY SCHEME OF ^{195}Tl. Vandlik, T. B.; Vandlik, Ya.; Zaitseva, N. G.; Makhunka, L.; Makhunka, M.; Mate, Z.; Tyrroff, Kh.; Fenesh, T.; Fominykh, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1804-1812(Sep 1973). (In Russian).

The γ, conversion electron, and γ-γ coincidence spectra of ^{195}Tl were measured with a semiconductor detector. The characteristics of the measured lines are tabulated. The decay scheme determined from these experimental data is given. The characteristics of the energy levels of ^{195}Hg, ^{197}Hg, and ^{195}Hg, obtained experimentally, are compared with the calculated results of Kisslinger and Sorensen. (2 figures, 2 tables) (JSR)

19775 STRENGTH FUNCTION FOR γ LINES OF ^{205}Tl AT EXCITATION ENERGIES UP TO 7.5 MeV. Earle, E. D.; Knowles, J. W.; Lone, M. A.; Bartholomew, G. A. (Chalk River Nuclear Lab., Ont.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1904-1910(Sep 1973). (In Russian).

The cross section for the quasi-elastic scattering ^{205}Tl(γ,γ)^{205}Tl of photons with energies from 3.5 to 7.5 MeV was measured. The intensity of the scattered photons was measured, and the dependence of the quasi-elastic scattering cross section on the energy of the incident photons was determined. It is shown that the irregularities in the behavior of the strength function of the ^{205}Tl γ rays are a feature of the strength function for three Tl isotopes both during excitation with photons and in neutron capture reactions. (4 figures, 1 table) (JSR)

19776 RADIOACTIVE HALOS. Gentry, R. V. (Oak Ridge National Lab., TN). Annu. Rev. Nucl. Sci.; 23: 347-362(1973).

A review is given of halos, tiny aureoles of discoloration in some thin samples of certain minerals, and their bearing on nuclear science. The radioactive origin and provenance of halos, evidence of constancy of radioactive decay energies over geological time, and variant halos and evidence for unknown radionuclides are discussed. (JFP)

19777 CROSS SECTIONS FOR THE PHOTONEUTRON REACTIONS ON ^{197}Au AND ^{209}Bi. Sorokin, Yu. I.; Khrushchev, V. A.; Yur'ev, B. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1890-1894(Sep 1973). (In Russian).

Curves of the total photoneutron yield from ^{197}Au and ^{209}Bi were measured at $E_\gamma < 29$ MeV. The cross section of the (γ,Tn) reaction was calculated by the method of Penfold and Leiss. The cross sections obtained for the photoabsorption were compared with theoretical calculations. The integrated cross sections for the (γ,Tn) reactions were 4.06 and 4.59 MeV-b for ^{197}Au and ^{209}Bi, respectively. (1 figure, 1 table) (tr-auth)

19778 INTERNAL BREMSSTRAHLUNG SPECTRA DURING ELECTRON CAPTURE BY ^{41}Ca AND ^{204}Tl. Zon, B. A. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1978-1980(Sep 1973). (In Russian).

The form factors of the internal bremsstrahlung spectra during forbidden unique ε transitions in ^{41}Ca and ^{204}Tl were calculated. The role of the final dimensions of the nucleus was discussed for ^{204}Tl. (1 table) (tr-auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 18075, 18479, 18485, 18486, 19374, 19653, 19681, 19696, 19729, 19732, 19735, 19762, 19763, 19770, 19771, 19776, and 19798.

19779 (COO-1167-31) TECHNICAL PROGRESS REPORT ON NUCLEAR CHEMISTRY RESEARCH. Sugarman, N.; Turkevich, A. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). 31 Dec 1973. 24p. Dep. NTIS $3.25.

Abstracts of several papers which have been published or accepted for publication are presented. Short summaries of work in progress during the period from April 1, 1973, through March 31, 1974, are also given. (RWR)

19780 (IEA-297) CROSS SECTION OF THE ^{238}U(γ,n)^{237}U REACTION NEAR THRESHOLD. Mafra, O. Y.; Cesar, M. F.; Kuniyoshi, S.; Goldemberg, J. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Fisica Nuclear). Jun 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The ^{238}U(γ,n)^{237}U reaction cross section has been measured by activation at excitation energies from 6.07 to 9 MeV. The (γ,n) cross section thus obtained has shown the same structure of the photofission cross section for the same element that will imply in the same structure in the total photoabsorption cross section. (auth)

19781 (MNC-4028-12) RESEARCH IN NUCLEAR CHEMISTRY. Annual Progress Report. Viola, V. E. Jr.; Gordon, G. E.; Walters, W. B. (Maryland Univ., College Park (USA). Dept. of Chemistry). 1 Nov 1973. Contract AT(40-1)-4028. 110p. Dep. NTIS $7.50.

Studies are reported in the following areas: fission of ^{197}Au, ^{209}Bi, and ^{238}U by ~140-MeV alpha particles and spontaneous fission of ^{252}Cf; radioactive decay of ^{103}Ru, ^{107}Cd, ^{131m}Te, ^{134}La, and isotopes of W, Os, Np, U, Pa, and Th; and nuclear reactions (including C + p and mechanism studies). The development of nuclear methods for analysis of environmental samples and the development of facilities are presented. Lists of theses, publications, and personnel are given. (24 figures, 13 tables) (RWR)

For title listings of selected papers see: 18232, 19703, 19747, 19762, 19763, and 19782-19784.

19782 (MNC-4028-12, pp 2-4) ANGULAR DISTRIBUTIONS OF SELECTED FRAGMENTS FROM FISSION OF ^{233}U AND ^{209}Bi. Aras, N. K.; Gordon, G. E.; Viola, V. E. Jr. 1 Nov 1973.

In research in nuclear chemistry.

19783 (MNC-4028-12, pp 22-26) RANGES OF FRAGMENTS FROM SPONTANEOUS FISSION OF ^{252}Cf. Mathews, G.; Harrison, G. 1 Nov 1973.

In research in nuclear chemistry.

19784 (MNC-4028-12, pp 58-64) STUDIES OF NEUTRON-DEFICIENT ACTINIDES. Schuster, P.; Clark, G.; Viola, V. E. Jr. 1 Nov 1973.

In research in nuclear chemistry.

19785 (UCID-16433) CALCULATION OF RESONANCE SELF SHIELDING IN ^{239}Pu. Plechaty, E. F.; Cullen, D. E. (California

Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1974. Contract 7405-eng-48. 20p. Dep. NTIS $3.00.

The 2000-group TART code and the ENDL cross section library were used to calculate the fissions as a function of depth in the flat Pu plate experiment of Czirr and Bramblett [Nucl. Sci. Eng., 28: 62 (1967)]. This experiment gives the ratio of the number of fissions with the Pu target in to the number with the target out; secondary fissions in the target do not contribute. Results from experiment and Monte Carlo calculations are given for thicknesses from 0.06 to 3.13 g/cm^2 in nine energy groups from 2.15 eV to 10 keV. It was found that the TART 2000-group structure was adequate since vast increases in the number of groups did not change the results. Where the total and fission cross section data are well known, the calculations and experiment were in reasonably good agreement. The only region of disagreement was in the unresolved resonance region above 300 eV. (11 figures, 1 table) (RWR)

19786 DECAY PROPERTIES OF SHORT-LIVED NEUTRON-RICH HALOGEN ISOTOPES AND THEIR YIELDS OBTAINED IN THE THERMAL NEUTRON FISSION OF URANIUM. Kratz, K. L. Mainz; Univ. Mainz (1972). 355p. (In German).

Thesis.

The present paper reports data on the nuclear charge distribution of halogen isotopes in the 50- and 82-neutron shell range resulting from thermal neutron fission of ^{235}U. A fully automated rapid gas-chromatographic system has been developed which allows the isolation of short-lived bromine and iodine isotopes by volatilization of their methyl compounds within a few seconds. By measurement of delayed neutrons as well as the gamma spectra of the halogens, the nuclides ^{86}Br to ^{92}Br and ^{136g,m}I to ^{141}I have been identified. The gamma lines of the noble gas daughters supported the mass assignment. Taking into account the decay data obtained in that way the relative independent bromine yields in the mass chain 87 to 92 with respect to ^{90}Br as well as the relative iodine yields in the mass chain 136 to 141 with respect to ^{139}I could be determined for the thermal fission reaction U(n,f). Moreover, a method is proposed for an evaluation of neutron emission probabilities of unknown neutron emitters, which is based on a relation to the maximum β-energy and the neutron binding energy. (86 figures, 89 tables, 179 references) (tr-auth)

19787 SEARCH FOR FISSION SHAPE ISOMERS IN (n,f) REACTIONS INDUCED BY NEUTRONS OF ABOUT 1 MeV. Mueller, R. (Univ., Tuebingen, Ger.); Goennenwein, F.; Kaeppeler, F.; Ernst, A.; Scheer, J. Phys. Lett.; 48B: No. 1, 25-27 (7 Jan 1974).

Upper limits for the isomer to prompt fission ratio were measured for the compound nuclei ^{236}U and ^{240}Pu excited by neutrons with energies in the 0.5–2.5 MeV region. From these data the differences in the barrier heights of the double-humped fission potential were calculated with a modified statistical theory. (auth)

19788 COLLISION DENSITY IN INTERMEDIATE RESONANCES. Platonov, A. P.; Luk'yanov, A. A. At. Energ. (USSR); 35: No. 1, 56-57(Jul 1973). (In Russian).

Neutron slowing in a two-component homogeneous medium at resonance energies is characterized by a real dependence of the collision density on the type of energy structure of the neutron cross sections. This behavior is clearly manifest near the intermediate resonances with a width close to the magnitude of the energy losses during elastic scattering of a neutron on nuclei of the resonance component. Taking into account the energy structure of the collision density near such resonances leads to a noticeable difference in the values of resonance integrals in separate energy groups and may be substantial in calculating the average-group characteristics in the resonance region. Resonance capture integrals for ^{238}U levels in UH and UO_2 media are calculated by a number of approximation methods for temperatures of 300, 600, and 900°K. Values of resonance integrals calculated for separate levels with various moderators differ noticeably from each other for all temperatures. (1 figure, 2 tables) (SJR)

19789 MASS ASYMMETRY IN FISSION. Vandenbosch, R. (Washington Univ., Seattle). Comments Nucl. Particle Phys.; 5: No. 6, 161-164(Nov 1972).

One of the earliest features observed in the study of fission was the preference for the nucleus to break up into two fragments of unequal mass, and this was found to be characteristic for the low energy fission of all fissioning nuclei with mass numbers between 230 and 254. Many models to account for the observed mass distributions have been proposed, but few have survived, and it seems fair to say that one of the first observations of fission has proved to be one of the most difficult to understand. Recently, however, the calculation methods used to reproduce successfully the double-humped barriers responsible for fission isomers and intermediate structure have been extended so as to shed considerable light on the origin of asymmetric mass distributions. Application of the macroscopic-microscopic method for calculating potential energy surfaces (Nucl. Phys.; A 95: 420 (1967)) is discussed; this method has had considerable empirical success in accounting for barrier heights and isomer excitation energies, and a schematic version of a potential energy surface for ^{236}U is shown. It is thought that mass distributions may be inferred by examining the valleys in the potential energy surface. Consideration is also given to nuclei much heavier than U, and it is stated that there are calculations that suggest that the heaviest Fm isotopes would be expected to fission symmetrically; there are also experimental results indicating an increasing tendency towards symmetric fission with increasing neutron number in Fm isotopes. The problems are stated to be of considerable interest at the present time, as new heavy ion accelerators make possible the study of the amalgamation of two very heavy nuclei. (UK)

19790 EFFECTIVE TREATMENT OF RESONANCE INTERFERENCE IN NEUTRON CROSS SECTIONS. Kitazoe, Y.; Suzuki, H.; Sekiya, T. (Osaka Univ., Suita, Japan). Atomkernenergie; 22: No. 2, 143(Oct 1973).

A method is described to evaluate interference effects between closely spaced resonance levels in neutron cross sections. Within the framework of R-matrix theory, an equation is derived which permits the iterative calculation of interference parameters with higher accuracy than using the well-known Sailor's formula. (2 figures, 1 table) (GE)

19791 NUCLEAR MOLECULES AND NUCLEAR FRICTION. Wilczynski, J. (Univ. of Copenhagen). Phys. Lett.; 47B: No. 6, 484-486(24 Dec 1973).

Experimental data on transfer reactions in the ^{40}Ar + ^{232}Th system are interpreted in terms of nuclear orbiting combined with dissipation of energy due to the friction forces. (auth)

19792 ^{232}Th FISSION YIELDS DETERMINATION BY γ-RAY SPECTROSCOPY ON UNSEPARATED SAMPLES. Brasca, M.; Cesana, A.; Sangiust, V.; Terrani, M. (CESNEF, Milan). Energ. Nucl. (Milan); 20: No. 12, 691-698(Dec 1973).

Gross fission products γ-ray spectra of ^{235}U (thermal fission) and of ^{232}Th (fission from reactor neutrons) were analyzed with a GeLi detector. Some yields for ^{232}Th were determined by the comparison method. (auth)

19793 DECAY OF ^{233}Pa TO THE LEVELS IN ^{233}U. Valkeapaene, T. (Helsinki Univ. of Tech., Otaniemi, Finland); Siivola, A.; Graeffe, G. Phys. Fenn.; 8: No. 1, 43-50(May 1973).

The decay of ^{233}Pa was studied by means of semiconductor detectors and coincidence techniques. In addition to the well known transitions and energy levels observed earlier in ^{233}U some weak gamma transitions were discovered at energies 41.5, 248.0, 258.2 and 298.5 keV. The coincidence measurements establish a new level at 298.5 keV, which was assigned to $^{7}/_{2}^{-}$[743] single particle neutron state based on systematics and gamma transition rates. (auth)

19794 MEASUREMENTS OF THE NEUTRON ENERGY SPECTRUM OF THE SPONTANEOUS FISSION OF ^{252}Cf. Knitter, H. H.; Paulsen, A.; Liskien, H.; Islam, M. M. (Commission of the European Communities, Geel, Belgium). Atomkernenergie; 22: No. 2, 84-86(Oct 1973).

Two energy spectra of the neutrons emitted in the spontaneous fission process of ^{252}Cf were measured in the neutron energy range between 0.15 and 15 MeV using nanosecond time-of-flight technique. In the first experiment the γ-rays accompanying the fission process were used to generate the time zero signals and in the second case the fission products themselves. As a neutron detector a carefully calibrated fast response detector was generating the timing signals for the neutrons. In both cases the shapes of the spectra agreed with a Maxwellian distribution within the experimental errors. An average energy anti E = 2.13 ± 0.08 MeV was obtained. (GE)

19795 STATISTICAL ASPECTS IN FISSION MECHANISM OF ACTINIDES. Facchini, U. (CISE, Milan); Pierini, G.; Saetta-Menichella, E. Energ. Nucl. (Milan); 20: No. 12, 667-677(Dec 1973).

The late stage of the fission process is studied in the case of low energy fission of actinide nuclei. It is shown, at first, that the average initial temperatures of the fragments are roughly constant for different fragment pairs and that the average angular moments follow a statistical distribution law. A statistical analysis is then given, where the internal degrees of the fragment pairs are assumed to be in statistical equilibrium, whereas the degrees related to the fragment motion are considered as not being in equilibrium with the internal degrees. The proposed model describes

the general properties of fission fragment excitation energies. (auth)

Nuclear Theory

Refer also to abstracts 19441, 19547, and 19795.

19796 (BNL-tr-559) SHELL-MODEL APPROACH TO NUCLEON–NUCLEUS ELASTIC SCATTERING. Zaretskii, D. F.; Urin, M. G. Translated by S. J. Amoretty from Yadern. Fiz.; 18: No. 3, 508-518(1973). 23p. Dep. NTIS $3.25.

The elastic scattering of low-energy nucleons by nuclei is described in terms of the shell-model approach to the theory of nuclear reactions. The expression for the average S matrix is generally different from the optical-model predictions. The specific differences of the two approaches are examined on the basis of the strength functions for slow neutrons. (auth)

19797 (CEA-R-4521) SOLID ANGLE SUBTENDED AT A POINT BY A CIRCULAR DISC. Gilly, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jan 1974. 107p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

Methods of calculation of solid angles, subtended by a circle at a point are analyzed. Complementary solid angle notion is introduced, it facilitates a connection between the solid angle subtended by a circle, and the solid angle subtended by a surface. A case in point is at an off-axis position, is described in detail: corresponding calculus are methodically classified as follow: series developments, defined integral, curvilinear integrals, elliptic integrals, electrostatic analogy, approximated geometric method. An original complementary study is made from JAFFEY's formula at the beginning. It is concerning variations of solid angles with different parameters. It leads to the notion of rectilinear and circular distributions which have properties of equal solid angles. Extrapolation of them in a rectangular space is also given. Applications in nuclear physics are added as examples. List of numerical tables complete bibliography. (auth)

19798 (IPNO/TH-73-19) SPHERICAL HARTREE–FOCK CALCULATIONS WITH EFFECTIVE INTERACTIONS. Flocard, H. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). Jun 1973. 45p. (In French). (CONF-730574-8). Dep. NTIS (U. S. Sales Only) $4.25.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

Two examples of Hartree–Fock calculations with effective interactions are presented: those made by Campi and Sprung using the local density approximation, and calculations made at Orsay using Skyrme effective interaction. In this second case parametrization is discussed, special emphasis being given to the influence of nonlocality for nonmagic nuclei. A set of parameters which predicts the total nuclear binding energies is obtained for all the elements of the mass table with a mean error of 5 MeV, pairing and deformation corrections being included. (auth)

19799 EXACT TREATMENT OF COLLECTIVE ROTATIONS. Part B. Applications. Ruder, H. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Z. Naturforsch.; 28a: No. 9, 1500-1515(1973). (In German).

Some applications and conclusions of the theory for collective rotations of quantum mechanical systems are considered. The consequences of a body-fixed coordinate-system lying in the principal axes of inertia are investigated. It is found that for this choice in general no specific decoupling is obtained, and therefore the so-called hydrodynamic moments of inertia are always a lower limit for the real moments of inertia of a system. Further the transition from an n-body system to the rigid body is carried out. The symmetry conditions of systems with identical particles are treated. Especially studied is the question of how to define the optimal body-fixed frame of reference in a system of independent identical particles. Finally the results of the exact theory of collective rotations are compared with the results of the cranking model and it is found that only in the limit of an infinitely heavy core the cranking model leads to an exact expression for the moment of inertia. (GE)

19800 POLARIZATION OF PROTONS FROM THE DEUTERON STRIPPING REACTION. Isoya, A. (Kyushu Univ., Fukuoka). Mem. Fac. Sci., Kyushu Univ., Ser. B; 4: No. 4, 97-109(May 1972).

Polarization of protons from the deuteron stripping reaction was calculated in the plane-wave Born approximation, using source terms consisting of the optical potentials produced by the target nucleus for proton and neutron. This treatment takes into account a situation that a proton and a neutron in the incident deuteron interact with the target nucleus rather independently of each other since the mean distance of both particles in the deuteron is considerable compared to the radius of the target nucleus. For the case of $l = 0$ orbital angular momentum transfer polarization is produced as interference between the diffracted wave caused by absorption and the scattered wave by the spin-orbit interaction. For the $l = 1$ case another type of polarization is produced, depending on the difference of the absorption strengths of both particles in the target nucleus, in addition to that depending on the spin-orbit interaction. (auth)

19801 STABILITY OF NEUTRON MATTER CALCULATIONS. Hillebrandt, W. (Univ., Cologne). Z. Phys.; 264: No. 4, 321-330 (1973).

The problem of the stability of usual Hartree–Fock calculations of neutron matter with effective two-body interactions is investigated by using the second order variational equations. Sufficient conditions for instability are derived, which can be checked easily for a given effective potential. Numerical calculations are performed and neutron matter is found to be unstable against density fluctuations. (GE)

19802 X RAYS IN ATOMIC AND NUCLEAR PHYSICS. Dyson, N. A. London; Longman (1973). 393p.

The subject covers the continuous x-ray spectrum, characteristic x-rays, experimental techniques for the study of x-rays, the absorption and scattering of x-rays, x-rays in radioactive decay, some additional fields of x-ray study (x-ray microscopy and microanalysis, chemical influences in absorption and emission — the isotope effect, mesonic x-rays, x-rays in plasma physics and astrophysics). An extensive bibliography is included. (UK)

19803 GOLDSTONE EXCITATION IN COUPLED PION–NUCLEON SYSTEM. Ohta, K. (Tokyo Univ.). Lett. Nuovo Cim.; 9: No. 2, 49-53(12 Jan 1974).

The polarization function is calculated for a pion moving in nuclear matter with the linear coupling to pions, and collective excitations of particle-hole pairs are discussed using a field-theoretic scheme. Approximations are made consistent with a generalized Ward identity, and it is examined how Goldstone excitations can occur in the interacting pion-nucleon system. (LBS)

19804 THEORY OF AUTO-IONIZATION IN ELECTRON-CAPTURE DECAY. Intemann, R. L. (Temple Univ., Philadelphia). Nucl. Phys.; A219: No. 1, 20-28(1974).

Existing theories of auto-ionization in electron-capture decay are reviewed. It is proved that the theoretical model recently developed by Law and Campbell is identical with an earlier theory due to the author. Disagreement between the final results obtained from these two theories is traced to additional approximations introduced by Law and Campbell in the course of their calculations. These approximations are critically examined and found to be invalid thus explaining the reported disagreement. The results of various theoretical calculations previously reported by the author are evaluated for several nuclei of interest. (auth)

19805 EXACT SHELL MODEL CALCULATIONS IN A = 17 AND A = 18 NUCLEI AND EFFECTIVE OPERATORS IN THE (2s,1d) SHELL. Lo Iudice, N. (Univ., Naples); Rowe, D. J.; Wong, S. S. M. Nucl. Phys.; A219: No. 1, 171-189(1974).

A shell model calculation in an enlarged space spanned by two particles in the (2s, 1d) shell and three-particle-one-hole $2\hbar\omega$ excitations is performed using the "bare" G-matrix. An effective interaction for the (2s, 1d) shell is generated and its convergence properties are investigated. It is maintained that the series converges reasonably fast in G and that the single-particle energies used in the calculation are instrumental in this respect. This conclusion is corroborated by the E2 effective charges and B(E2) strengths that are computed for A = 17 and A = 18 nuclei respectively. (auth)

19806 MICROSCOPIC TREATMENT OF THE VIBRATION STATE OF DEFORMED NUCLEUS. Ch'eng, T. S.; Tseng, C. Y. (Univ., Peking). Wu-li; 2: No. 2, 53-74(May 1973). (In Chinese).

A new method of treating long-range forces is proposed. It is based on the method of conservation of the number of interacting particles. The method was used to analyze the microscopic structure of the vibrational state of the heavy deformed nucleus. The vibrational state of a deformed nucleus is considered to be a mixture of the "mutual dispersion state" and "mutual excitation state" with the same K^{π} under the influence of long-range forces (4-pole forces, 8-pole forces). Formulas were derived for the matrix elements of the long-range forces for both the "mutual dispersion state" and the "mutual excitation state." This method circumvents some of the difficulties encountered in treating vibrations based on the BCS method, such as nonconservation of particle number, false state, nonorthogonality of the wave functions, etc. It does not require the simplifying assumptions used in the RPA method. Furthermore, the different block effects of the

ground state or the excited state are automatically taken into account. The np force plays an important part in causing the appearance of the vibrational state. As illustrations, the internal structures of the γ vibration of the rare-earth group nucleus and of the β vibrational state of the actinium group nucleus were analyzed. The following were demonstrated: variation of the position of the vibrational band with different nuclei; significant increase in the probability of leaping from the ground state to the vibrational state; the appearance of a low-energy vibrational band in heavy deformed nuclei. In addition, by using ^{165}Ho as an example, the γ vibrational states of the odd-A nucleus were analyzed: they are considered to be the mixture of a three-particle state and the single-particle state with identical K^{π}. In this case, the blocking effect plays an important part. (JPRS)

19807 STUDY OF THE VARIABLE MOMENT OF INERTIA MODELS. Ullah, N. (Tata Inst. of Fundamental Research, Bombay). Pramana; 1: No. 5, 209-211(Oct 1973).

The variable-moment-of-inertia (VMI) model proposed by Holmberg and Lipas is shown to be a special case of the VMI model of Mariscotti et al. The solution of Mariscotti's model is expressed in terms of hypergeometric functions, which directly give the rotational energies or their expansions in terms of the quantity F(F + 1), where F is the total angular momentum. The present way of looking at the VMI model also tells us how to write the general dependence of the vibrational energy and the moment of inertia on the energy E_J. (auth)

19808 INTERPRETATION OF COLLECTIVE HYPERNUCLEAR STATES PRODUCED IN STRANGENESS-EXCHANGE REACTIONS. Auerbach, N. (Rutgers-The State Univ., New Brunswick, NJ); Gal, A. Phys. Lett.; 48B: No. 1, 22-24(7 Jan 1974).

The concept of strangeness analog resonance may not be useful for describing low momentum transfer strangeness exchange reactions on nuclei. A band of collective excitations is expected where the lowest and most enhanced one is invariably around 10 MeV above hypernuclear ground state. (auth)

19809 ESTABLISHMENT OF THE FORM FACTORS FORMULAE FOR BETA TRANSITIONS BETWEEN NUCLEAR STATES DESCRIBED BY QUASIPARTICLE–PHONON INTERACTION. Bogdan, D.; Gretu, T.; Macarie, G. (Inst. for Atomic Physics, Bucharest). Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucuresti; 35: No. 4, 41-49(1973). (In Rumanian).

Form factors formulas for beta transitions between nuclear states described by the quasiparticle–phonon interaction are established. The calculational method is based on the semi-microscopic theory of nuclear interactions. (auth)

19810 LEKTSII PO MIKROSKOPICHESKOI TEORII ATOMNOGO YADRA. (Lectures on the Microscopic Theory of Atomic Nuclei). Krainov, V. P. Moscow; Atomizdat (1973). 224p.

The simplest theoretical representations of the structure of nuclei are discussed. Special attention is given to the popular description of the microscopic methods widely used in the scientific literature on nuclear physics. A large number of the methods are examined graphically. Modern representations of the ground and low-lying excited states of nuclei are given. (tr-auth)

19811 LEAST-SQUARES DEFECT MINIMIZATION IN NUCLEAR-REACTION THEORY. Schmid, E. W. (Univ., Tuebingen, Ger.). Nuovo Cim.; 18A: No. 4, 771-786(21 Dec 1973).

It is shown that in nuclear-reaction theories which diagonalize the Hamiltonian in a test function space false resonances arise when an open channel is neglected. A least-squares principle is discussed which does not lead to false resonances. Additional conditions can be introduced in the least-squares equation to suppress centre-of-mass excitations in shell model reaction theory. (auth)

19812 SUPPRESSION OF FALSE RESONANCES IN THE RESONATING-GROUP METHOD. Schwager, J. (Univ., Tuebingen, Ger.). Nuovo Cim.; 18A: No. 4, 787-793(21 Dec 1973).

It is shown in a numerical example that false resonances arise in the resonating-group method when an open channel is neglected. They can be suppressed by a least-squares defect minimization method which has been developed recently. (auth)

19813 DETERMINATION OF THE OPTICAL-MODEL POTENTIAL IN TERMS OF THE DIFFRACTION MODEL PARAMETERS. Haider, W.; Ahmad, I. (Aligarh Muslim Univ., India). J. Phys., A (London); 6: No. 12, 1943-1948(Dec 1973).

The determination of the optical-model potential for a high energy charged particle using the diffraction model phase shifts is discussed. It is shown that the finiteness of the nuclear charge distribution hitherto neglected makes a positive contribution to the real part of the calculated potential at small distances. It is further observed that the form of the calculated potential is very much dependent on the model used for parametrizing the phase shifts. (auth)

19814 CALCULATION OF REACTION MATRIX ELEMENTS IN NUCLEAR MATTER AND NEUTRON MATTER. Baeckman, S. O. (Aabo Akademi, Turku, Finland); Sjoeberg, O. Acta Acad. Abo., Ser. B; 33: No. 8, 1-6(1973).

Procedures for obtaining reaction-matrix elements in a uniform medium are presented. In configuration space a technique is used involving a solution of linear equations thereby avoiding problems of convergence. In momentum space Gaussian integration is used. The different methods give results that agree within computational accuracy. (auth)

19815 RENORMALIZATION OF TWO BODY MATRIX ELEMENTS AND THE QUADRUPOLE–QUADRUPOLE FORCE IN THE sd SHELL. Strottman, D. (Oxford Univ.). Particles Nucl.; 6: No. 2-3, 55-75(1973).

The importance of the correction terms to the bare matrix elements of Kuo and the possibility of replacing the renormalized G matrix by the bare G matrix plus a quadrupole–quadrupole force of appropriate strength are examined for several particle systems. It is found that other types of forces, particularly the pairing force, are essential in order to obtain agreement. The effect of the various corrections on the validity of SU_3 is examined. (auth)

19816 SYMMETRIES IN NUCLEI. Hecht, K. T. (Univ. of Michigan, Ann Arbor). Annu. Rev. Nucl. Sci.; 23: 123-161(1973).

A review is given of symmetries in the vector spaces of the nuclear shell model, the goodness of nuclear symmetries, and the irreducible tensor formalism as a calculational tool. (JFP)

19817 LINEAR RELATIONS AMONG NUCLEAR ENERGY LEVELS. Koltun, D. S. (Univ. of Rochester, NY). Annu. Rev. Nucl. Sci.; 23: 163-192(1973).

The linear spectroscopic factors for nuclear spectra associated with simple configurations are investigated from two points of view, showing two ways in which effective interactions are treated in shell model theory. First the interactions are considered as theoretically unknown, and experimental spectra are used to determine features of the interaction. Also the many-body theory of effective interactions that connects the shell model of nuclear spectra back to the Schroedinger equation for nuclei with interaction nucleons is used for spectral relations. It is shown that this question can also be formulated in terms of effective many-body interactions, and the linear spectroscopic relations. (JFP)

19818 INTERMEDIATE STRUCTURE IN NUCLEAR REACTIONS. Mahaux, C. (Univ., Liege). Annu. Rev. Nucl. Sci.; 23: 193-218(1973).

A detailed experimental and theoretical investigation of intermediate structure is given covering intermediate structure in bound states, resonance reactions, statistical analysis, experimental data, and doorway states without intermediate structure. (JFP)

19819 MANY FACETS OF NUCLEAR STRUCTURE. Bohr, A.; Mottelson, B. R. (Niels Bohr Inst., Copenhagen). Annu. Rev. Nucl. Sci.; 23: 363-393(1973).

The review of nuclear structure covers early developments, the nucleus as a quantal many-body system, the interplay of shell structure and nuclear deformations, interaction of nuclear matter in bulk (heavy ion reactions), elementary modes of excitation in a unified description of nuclear dynamics, the fine-grain structure of nuclear matter (high energy probes), and statistics of quantal states for the compound nucleus. Also covered are the strength function for direct interactions, isobaric analog resonance, collective modes in the nuclear pair field (two-particle transfer reactions) rotational spectra, generalized rotational motion, phase transitions induced by rotational perturbation in the Yrast region, and connections to other fields. (auth)

19820 ISOSPIN PURITY OF LEVELS OF LIGHT NUCLEI. Kostin, V. Ya.; Kopanets, E. G.; Koval, A. A.; L'vov, A. N.; Migalenya, V. Ya.; Tsytko, S. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1846-1849 (Sep 1973). (In Russian).

On the basis of an isospin selection rule for E1 transitions of self-conjugate nuclei, an analysis was made of the probability distribution of E1 transitions, and the mean value of the probability of permitted and forbidden E1 transitions in nuclei of the 1d2s shell was obtained. The magnitudes of the mixing $\alpha^2_{\frac{1}{2}}(T')$ of levels with $T' = 0$ and $T = 1$ were determined for these nuclei. The mean value of the matrix element of the Coulomb interaction $\langle H^{C}_{T'T} \rangle$ leading to the isospin mixing was also determined. The

reduction of isospin mixing in filled subshells was indicated. (2 tables) (tr-auth)

19821 ELECTROMAGNETIC TRANSITIONS OF ODD–ODD NUCLEI. Rozantsev, L. N.; Evstaf'ev, N. N. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1850-1859 (Sep 1973). (In Russian).

The results were reported of the analysis of the probability of electromagnetic transitions for a series of odd–odd nuclei with $10 \leq A \leq 42$ from bound states, the majority of which were strongly excited in direct nuclear reactions. The analysis was carried out in the framework of the effective moment model. The probabilities of intermultiplet and intramultiplet transitions were expressed by the probability of analogous transitions of neighboring odd nuclei and their static moments. (1 table) (tr-auth)

19822 ANGULAR DISTRIBUTION OF THE γ QUANTA FROM ORIENTED NUCLEI TAKING ACCOUNT OF THE HIGHER-ORDER APPROXIMATION OF PERTURBATION THEORY. Kuzhir, P. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1833-1834(Sep 1973). (In Russian).

An expression was obtained for the angular distribution of the γ quanta emitted by oriented nuclei, taking account of the third order of perturbation theory. The contribution can be quite considerable for small transition energies and for high atomic shells. (tr-auth)

19823 STATIONARITY OF THE BCS FUNCTION PROJECTED ACCORDING TO THE NUMBER OF PARTICLES AND THE ENERGY OF THE TWO-QUASI-PARTICLE STATE. Kuz'menko, N. K.; Mikhailov, V. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1911-1919(Sep 1973). (In Russian).

From the conditions of stationarity of the BCS function, projected according to the number of particles, the basic equations of the FBCS Method (variation after projection) were obtained. The energies of the lowest nonrotational states with large spins were calculated for the neutron systems of even–even nuclei in the region of rare earth elements. A comparison was made of the results obtained with experimental data. (1 table) (tr-auth)

19824 PARAMETRIZATION OF THE AMPLITUDE OF THREE-PARTICLE REACTIONS. I. Quasielastic Breakup of the Deuteron. Zakhar'ev, B. N.; Luk'yanov, V. K.; Titov, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1920-1928(Sep 1973). (In Russian).

The parametrization of three-particle scattering amplitudes is considered for those cases characterized by sufficiently large momenta of the relative motion of the particles. Some typical curves of the scattering energy and angular distributions of particles in deuteron breakup reactions are shown. From the curves it is seen that with increase of the smearing out parameter in the matrix determining the character of the relative motion of the neutrons and deuterons the energy distribution curves are sharpened. The tendency toward uniform distribution of energy between neutrons and deuterons increases with decrease of their flight angle. (JSR)

19825 DISPERSION K-MATRIX APPROACH TO DIRECT NUCLEAR REACTIONS. Blokhintsev, L. D. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1953-1958(Sep 1973). (In Russian).

An approach was proposed for the description of nuclear reactions, based on the assumption that the basic contribution to the matrix element of the K matrix of the reaction, examined as an analytical function of the variable $z = \cos\theta$ (θ is the scattering angle), is the closest to the physical region of the singular point of this function. The analytical properties of the elements of the K matrix were discussed with respect to z and energy. A relation was established between the characteristics with respect to the z elements of the K matrix and the S matrix. It was shown that the position of the poles in z and the residues to these poles of K-matrix and S-matrix elements coincide. Approximation formulas were derived expressing the reaction amplitudes through nondiagonal elements of the K matrix and elastic scattering amplitudes. The proposed approach guarantees the unitarity of the S matrix. (tr-auth)

19826 SIMPLE MODEL FOR THE DESCRIPTION OF PAIRING CORRELATIONS IN EXCITED NUCLEI. Ignatyuk, A. V.; Shubin, Yu. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1947-1952(Sep 1973). (In Russian).

The behavior of the density of states of excited nuclei was studied, allowing for pairing correlations of the superconducting type. The model examined does not use the usual assumption on the constancy of the matrix elements of the pairing interactions. For the thermodynamic characteristics of the nuclei, simple expressions determining their behavior in the superconducting phase were obtained. The very low value of the condensation energy in comparison with the traditional model made it possible to anticipate a significant increase in the density of excited states for nuclei above the phase transition point. (tr-auth)

19827 INTERNAL BREMSSTRAHLUNG ACCOMPANYING β DECAY OF NUCLEI WITH AN ARBITRARY DEGREE OF FORBIDDENNESS. Almaliev, A. N.; Batkin, I. S. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1981-1990(Sep 1973). (In Russian).

The relativistic and Coulomb effects being taken into account, formulas were obtained which made it possible to calculate the internal bremsstrahlung spectra accompanying β decay with an arbitrary degree of forbiddenness. (3 figures) (tr-auth)

19828 LEGKIE I PROMEZHUTOCHNYE YADRA VBLIZI GRANITS NUKLONNOI STABIL'NOSTI. (Light and Intermediate Nuclei Near the Limits of Nucleon Stability). Baz, A. I.; Gol'danskii, V. I.; Gol'dberg, V. Z.; Zel'dovich, Ya. B. Moscow; Izdatel'stvo Nauka (1972). 171p.

Problems of the existence and properties of nuclei near the limits of nucleon stability and related problems of analog states are considered. A survey is given of available experimental data on boundary isotopes and the possibilities of predicting the mass of as yet unobserved nuclei, and other properties of these isotopes are examined in detail. The basic experimental methods of searching for new nuclei and for investigation of analog states are discussed. The possibilities for the detection of new forms of radioactive decay of nuclei near the limits of nucleon stability such as proton and two-proton radioactivity are analyzed. A theoretical examination was made of the possibility of the existence of strongly neutron-excess and purely neutron nuclei. (tr-auth)

19829 CALCULATION OF THE TWO-PARTICLE DENSITY MATRIX FOR THE EXCITED $U_{3(n-1)}$ STATES OF LIGHT NUCLEI. Yankauskas, K. I.; Sabalyauskas, L. Yu.; Petrauskas, A. K. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 13: No. 5, 667-682(1973). (In Russian).

The calculation of the two-particle density matrix for excited $U_{3(n-1)}$ states is discussed. The method of determination of the two-particle fractional parentage coefficients, serving for the construction of the two-particle density matrix, is proposed. Numerical tables of the density of the central-force operator for excited $U_{3(n-1)}$ states with the number of quanta $E = E_{min} + 1$, $E_{min} + 2$ for nuclei with $n \leq 16$ are presented. (11 tables) (auth)

19830 CALCULATION OF THE CROSS SECTION OF PHOTONUCLEAR REACTIONS FROM EXPERIMENTAL DATA. Tikhonov, A. N.; Shevchenko, V. G.; Zaikin, P. N.; Ishkhanov, B. S.; Mechenov, A. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 3, 317-325(1973). (In Russian).

Some questions of the numerical determination on the computer of the cross section of photonuclear reactions from experimentally measured yield curves were examined. The modification of the Penforld–Leiss method with parametrization of the processing step regularizing algorithm, in which the degree of smoothness of the approximation emerges as a selection criterion, was described. A simulation was reported for illustration of the efficiency of the use of this algorithm. (tr-auth)

19831 FORM FACTORS FOR HEAVY ION TWO-NUCLEON TRANSFER REACTIONS. Feng, D. H.; Ibarra, R. H.; Mani, G. S.; Vallieres, M. (Univ. of Manchester, Eng.). Phys. Lett.; 47B: No. 6, 477-480(24 Dec 1973).

A method is developed to calculate form factors for the two nucleon transfer reactions induced by heavy ions by incorporating the "exact" solutions for the nuclear overlaps. The Sawaguri and Tobocman method is generalized to translate the shifted two nucleon overlap. It is shown that at the surface and beyond, higher orbitals play a major role in building up the strength of the form factor. (auth)

19832 INELASTIC SCREENING IN SCATTERING OF HIGH-ENERGY NUCLEONS BY COMPLEX NUCLEI. Karmanov, V. A.; Kondratyuk, L. A. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 266-268 (5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 451-454(5 Oct 1973).

The contribution of inelastic screening to the total nucleon–nucleon interaction cross sections at high energies is considered. The effect is connected mainly with the mechanism of diffraction dissociation, amounts to ~2 to 3% at an energy $E \geq 10$ GeV, and increases logarithmically with increasing energy. (auth)

19833 METHOD FOR THE DIAGRAM SUMMATION FOR THE ANALYSIS OF MULTIPARTICLE NUCLEAR REACTIONS. Komarov, V. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1991-1999(Sep 1973). (In Russian).

The amplitudes for the interaction of deuterons with nuclear potentials were examined. The application of the diagram summation method to the study of reactions proceeding through the compound nucleus with its subsequent decay into several particles is shown. (2 figures) (tr-auth)

19834 PERTURBATION THEORY OF A MANY-FERMION SYSTEM. II. Expansions in Reaction Matrices. Jones, R. W. (Univ. of Arizona, Tucson); Mohling, F.; Becker, R. L. Nucl. Phys.; A220: No. 1, 45-83(1974).

Currently, the most satisfactory version of Brueckner theory from the formal point of view is the generalized-time-ordered series of Brandow. In this formalism the Brueckner-Hartree-Fock (BHF) self-energy for normally empty ("particle") states does not factorize, and for this reason it is not included in the single-particle potential, U. This feature of the theory leads to differences between single-particle and separation energies, and between U and the real part of the optical potential. The time-dependent Green function formulation was used previously to achieve more extensive factorization, with the consequence that U could be defined to include the leading terms of the on-energy-shell BHF potential for "particles". This earlier expansion is written in terms of Brueckner reaction matrices, and the low orders of the resulting series are investigated. For this task, it was found more convenient to employ the Fourier-transformed formalism of energy-dependent Green functions, G (ω). First, diagram rules for expansions in the bare interaction, V, and an arbitrary U are given in sufficient generality to apply to finite systems, for which U and G (ω) are not diagonal matrices. The binding energy is expressed in terms of closed, propagator-renormalized, ω-dependent, ground state diagrams including over-counting corrections. Then U is chosen in terms of the real part of the proper self-energy. In the framework employed here U may be defined conveniently to be hermitian. A prescription, stated with remarkable simplicity in the G (ω) formalism, is obtained for converting an expansion in V to one in a general transition or reaction matrix. The U is the quasi-particle separation-energy potential, containing on-energy-shell self-energies of all topologies. For example, when the reaction matrix is that of Brueckner, the first-order (BHF) and second-order ("rearrangement energy") insertions are shown to be included in U both for "particles" and holes. Truncation schemes based on a stationary property of the propagator-renormalized series are explored. The simplest is a renormalized BHF approximation similar to that for Brandow's expansion but differing from it by containing the RBHF potential for "particle" states, which implies a smaller energy gap and greater diffuseness at the Fermi surface; and propagator renormalization ("line weighting") factors which contain single-particle density matrices ("true occupation probabilities") as in Brandow's expansion, plus "folded" terms. The formulation allows a close connection between "virtual" and "valence" single-particle states, while staying close to the computationally successful framework of the Brueckner theory and avoiding complex energies. (auth)

19835 PECULIARITIES OF THE QUANTO-MECHANICAL SPACE-TIME DESCRIPTION. Papp, E. (Institutul Politehnic, Cluj). Int. J. Theor. Phys.; 8: No. 6, 429-441(1973).

The analysis of the meaning and the role of space-time quanta is dealt with. A consistent mathematical description of the nontransitive binary "equivalence" is obtained. In connection with the existence of certain threshold velocities some peculiarities of the high energy behavior of scattered nucleons are explained. (auth)

19836 QUARK-LIKE MODEL OF HIGH DENSITY MATTER. Iachello, F. (Politecnico, Turin); Langer, W. D.; Lande, A. Nucl. Phys.; A219: No. 3, 612-620(1974).

High density matter is discussed in a quark-like model with integrally charged quarks and massless gluons. It is qualitatively shown that a baryon solid phase may develop at $\rho \approx 2-3$ times nuclear matter density. (auth)

19837 QUANTITATIVE DESCRIPTION OF THE INTERFERENCE BETWEEN THE ELASTIC SCATTERING OF HEAVY IONS AND ELASTIC TRANSFER REACTIONS. Gelbke, C. K.; Hildenbrand, K. D.; Weiss, W.; Bock, R. (Max Planck Inst. of Nuclear Physics, Heidelberg). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1971-1977(Sep 1973). (In Russian).

It is shown that during elastic scattering of heavy ions, differing from each other in only a few nucleons, the deviations of the experimental data from the predictions of the optical model can be quantitatively explained by exchange effects. (7 figures, 1 table) (tr-auth)

19838 MIXING OF BANDS WITH $\Delta K > 1$. May, F. R.; Munchow, L.; Frauendorf, S. (Central Inst. of Nuclear Research, Rossendorf, Ger.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 9, 1860-1862(Sep 1973). (In Russian).

The direct coupling of the bands of odd nuclei with $\Delta K > 1$, together with consideration of the coupling through several bands, was studied on the basis of angular momentum projection. The results agree well with spectroscopic data. (2 tables) (tr-auth)

19839 PHENOMENOLOGICAL INTERACTION CURRENTS IN NUCLEAR SYSTEMS. Lock, J. A. (Case Western Reserve Univ., Cleveland); Foldy, L. L.; Buskirk, F. R. Nucl. Phys.; A220: No. 1, 103-113(1974).

Beginning with the differential conservation law for electric charge, the electromagnetic current density operator for a nuclear system is decomposed into one-body and two-body terms. The two-body or interaction current density is further separated into a longitudinal part which is related to the charge exchange part of the nuclear force and a transverse part, depending on the nucleons' dynamical variables, and containing a large number of arbitrary parameters. In determining all the linearly independent irreducible vectors formed from the relative position vectors R_l and R_k and the nucleon spin vectors σ_l and σ_k, which may be present in the transverse current density, the method of group characters is used. Along with these spin-space vectors, all linearly independent irreducible spin-space scalars, pseudoscalars, and pseudovectors are also calculated. These linearly independent vectors are then used together with the various symmetry properties of the current density to determine the most general form the transverse current density can assume. In a similar manner, the most general form of the Fourier transform of this current density operator is determined. Lastly, the form of the axial vector weak current density arising from mesonic exchange effects in β-decaying nuclei is derived again by using the spin-space pseudovectors and the various symmetry properties of the weak current density. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

19840 (TID-3557-S9) CONTROLLED FUSION AND PLASMA RESEARCH. A Literature Search. Whitson, M. O. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 564p. Dep. NTIS $13.60.

This search includes 4348 references on various aspects of plasma physics and controlled thermonuclear research. Report number, corporate author, and subject indexes are included. (auth)

Confinement and Heating

19841 (COO-2230-1) PLASMA HEATING AND CONFINEMENT AT HIGH TEMPERATURES. Final Report. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Plasma Studies). 1973. Contract AT(11-1)-2230. 114p. Dep. NTIS $7.75.

Separate abstracts were prepared for the four included papers. (MOW)

For abstracts of individual sections see: 19842, 19853, 19865, and 19866.

19842 (COO-2230-1, pp 2b.1-2b.17) APPLICATION OF QUASILINEAR THEORY TO THE CORNELL TURBULENT HEATING EXPERIMENTS. Mondelli, A.; Ott, E. Jun 1973.

In plasma heating and confinement at high temperatures.

Quasi-linear theory was applied to the Cornell turbulent heating experiments with the inclusion of the actual external circuitry of the experiments in the model. The resulting set of coupled, first-order, ordinary differential equations are integrated numerically by the Runge–Kutta–Gill technique. A one-dimensional model with Maxwellian electrons and ions, assuming a current-driven ion-acoustic instability as the heating mechanism, is employed. The observed high-energy ion component is therefore excluded from the analysis. The computed current and voltage vs. time have several significant points of agreement with those in the experiments, including the "spikey" structure observed in the voltage traces and the premature quenching of the instability noted in the experiments. The computed final ion temperature is in reasonable agreement with the experimentally observed bulk ion temperature (excluding the high-energy ion tail). The total electron plus ion final temperature is consistent with the diamagnetic signals observed in the experiments. The premature turnoff of the instability appears to be due to ions heating more efficiently than electrons, resulting in a decrease of T_e/T_i, which stabilizes the instability. As the electron drift velocity rises, the instability turns on and off several times, until T_e/T_i has decreased to the point where the drift velocity can no longer cross the threshold for instability. The observed voltage spikes are due to the successive recurrences of the instability. The duration of the computed voltage spikes is in good agreement with the experimentally observed voltage traces. (auth)

19843 C-STELLARATOR. A Review of Containment. Young, K. M. (Univ. of Manchester, Eng.). Plasma Phys.; 16: No. 2, 119-152(Feb 1974).

In the C-stellarator, the containment of many different types of plasma was studied. They ranged from high-current density, high-plasma density, ohmically heated plasmas which could be compared to the plasmas of the T-3 and TS Tokamaks down to tenuous cold plasmas which could be compared to those investigated in the Wendelstein II stellarator. The electron temperature range covered was greater than three orders of magnitude (0.1 eV $\lesssim T_e \lesssim$ 240 eV) and the electron density range greater than five orders of magnitude (1×10^9 cm$^{-3} \lesssim n_e \lesssim 2 \times 10^{13}$ cm^{-3}). The observed data from the C-stellarator was compared with those for similarly produced plasmas in numerous other stellarators and conclusions were drawn on the inferences for any future stellarator investigations. (auth)

19844 PLASMA LOSSES IN THE RING SLIT OF AN ELECTROMAGNETIC TRAP. Pankrat'ev, Yu. I.; Tulin, N. A.; Ponomarenko, E. F.; Naboka, V. A. At. Energ. (USSR); 35: No. 4, 253-257(Oct 1973). (In Russian).

The effect of diocotron instability on plasma losses in the ring slit of an electromagnetic trap was examined. It was found that the instability growth disturbs the initial symmetry of the electron layer in the ring slit. Secondary plasma generated by ionization of residual gas in the trap increases the instability growth rate. The instability can be suppressed by shorting one of the surface diocotron waves by a conducting wall of the magnet slit. (auth)

19845 ELECTROMAGNETIC FIELDS IN A PLASMA PRODUCED DURING HEATING NEAR THE LOWER HYBRID FREQUENCY. Skosyrev, Yu. V.; Krivov, N. A.; Glagolev, V. M. At. Energ. (USSR); 35: No. 4, 259-262(Oct 1973). (In Russian).

Radial and longitudinal microwave fields in a plasma were measured during its heating near the lower hybrid resonance. It was observed that, at the moment of heating, these fields increased and their phase varied appreciably. This suggests that the heating is related to the generation of slow plasma waves in the plasma. (auth)

Diagnostics

19846 (IPPJ-T-13) SPATIAL FOURIER ANALYZER. Ogata, A.; Adati, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1973. 15p. NTIS (U. S. Sales Only).

The device described calculates the Fourier coefficients and power spectral densities of spatially periodic signals picked up from a set of magnetic probes positioned toroidally in a torus or around a plasma in a plane perpendicular to the magnetic axis in a linear machine or a torus. Time variations of each coefficient and power spectral density are displayed on oscilloscopes with large signal bandwidth up to 10 MHz. (auth)

19847 (NP-19940) MICROWAVE INTERFEROMETER WITH DIGITAL READ-OUT FOR LARGE NUMBERS OF FRINGES. Hugenholtz, C. A. J.; Putter, A. J. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Sep 1973. 8p. Dep. NTIS (U.S. Sales Only) $3.00.

The large number of fringes from a microwave interferometer if applied to large-dimension, high-density plasmas—e.g., in modern tokamak experiments, makes read-out increasingly difficult. For this reason, fringe counters are designed with which the number of fringes (or half fringes) can be recorded as a function of time. (auth)

19848 DETERMINATION OF THE CONCENTRATION OF IONS AND ELECTRONS IN PLASMA BY ABSORPTION OF LASER RADIATION. Razmadze, N. A.; Chkuaseli, Z. D. Zh. Prikl. Spektrosk.; 19: No. 4, 628-631(Oct 1973). (In Russian).

An argon laser with 24-W power was used for the determination of the electron concentration in plasma. The plasma was formed by discharges of the theta-pinch type in a deuterium–argon gaseous mixture. The laser beam (4880-Å Ar^+) was transmitted through the pinch plasma and the concentration of the Ar ions, originating by excitation of the $4s^2P_3$ level was determined by the size of its attenuation. It was shown that the population of this level was determined by the balance between the collision excitation and the spontaneous decay. The value of the electron concentration, averaged over the whole volume of the pinch plasma, was calculated. For comparison, the determination of the electron concentration was also carried out on the basis of the measurement of the Stark broadening of the D_β line. Conclusions were made on the prospects for the use of the absorption method for the control of the electrical power supply regime of plasma devices during their operation (feedback). (tr-auth)

19849 DIAGNOSTIKA PLAZMY. Vypusk 3. (Plasma Diagnostics. Issue 3). Luk'yanova, S. Yu. (ed.). Moscow; Atomizdat (1973). 560p.

A series of articles on the improved processing, analysis, and application of experimental methods for the study of hot plasma is compiled. Ninety papers from Soviet and foreign workers covering almost all areas in plasma diagnostics are presented: optical (spectroscopy, interferometry, holography, and lasers), corpuscular (passive and active), and microwave methods of study. There are papers on correlating methods of analysis and automation of the processing of experimental results. New and original experimental methods are also given. (tr-auth)

19850 SIMPLE SPECTROSCOPIC TECHNIQUE FOR THE ARC REGION OF PLASMA ACCELERATORS. Collier, R. P.; Scott, D. S. (Univ. of Toronto). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 1, 103-105(Jan 1974).

A simple method is proposed to provide radial profiles of intensity in the arc region, without modification of the electrodes, and without need for numerical inversion of the measured data. Results are compared with intensity measurements in the exhaust plume. (MOW)

19851 DETERMINATION OF ELECTRON DENSITY AND ELECTRON COLLISION FREQUENCY IN A PLASMA BY AN RF NONIMMERSIVE PROBE. Basu, J.; Maiti, J. N. (Saha Inst. of Nuclear Physics, Calcutta). J. Appl. Phys.; 44: No. 9, 3975-3979 (Sep 1973).

A method is presented for determining the electron density and electron collision frequency in a cylindrical plasma column by placing an rf coil coaxially around the plasma and measuring the coil impedance. Simplified expressions relating the impedance to plasma parameters are found to be valid under certain suitable conditions. The plasma of a hot-cathode low-pressure dc discharge in argon was studied by an rf coil probe. The dependence of electron collision frequency on electron velocity was taken into account. The values of the electron density and average collision frequency, as obtained from the rf probe under different discharge conditions, are in fairly good agreement with those given by a cylindrical Langmuir probe. (auth)

Kinetics (General)

Refer also to abstract 19675.

19852 (AAEC/E-280) SOME X-RAY AND NEUTRON MEASUREMENTS ON THE DENSE PLASMA FOCUS. Hogg, G. R.; Tendys, J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Measurements of the x-ray and neutron emissions from a dense plasma focus device given include time-integrated x-ray photographs of the focus, time-dependent x-ray neutron output characteristics, and average neutron-energy measurements determined by time-of-flight. The time of emission of x-rays and neutrons was correlated with the time differential of the plasma current and the results of Bernstein et al. (1969) confirmed. When the focus was operated with a negative center electrode, the x-ray and neutron emission was ≈0.25% of that obtained under identical conditions with a positive center electrode. (auth)

19853 (COO-2230-1, pp 2a.1-2a.29) MODULATED BEAM–PLASMA INTERACTION. Mondelli, A. A.; Auer, P. L. Sep 1972.

In plasma heating and confinement at high temperatures.

A density-modulated relativistic electron beam can resonantly interact with a mode of a background plasma to effect a rapid transfer of energy from the beam to the plasma. The modulated beam was modeled with a finite train of N charged discs in uniform translation along the direction of an externally applied magnetic field. This structure is allowed to interact with a cold, uniform plasma in a magnetic field. The beam-driven fields in the plasma are computed, with particular attention given to the "synchronous" modes ($\omega/k_{||} = V_0$). In the high-density limit, $\omega_{pe}^2 >> \Omega_e^2$, the plasma has a synchronous mode at the lower-hybrid frequency, $\omega = (\Omega_e\Omega_i)^{1/2}$. The rate of resonant energy transfer from the beam to this mode, and the characteristic time required for the energy transfer are calculated. For typical parameters, this transfer time is found to be short compared with the beam pulse duration. (auth)

19854 (IPPCZ-167) VI CZECHOSLOVAK SEMINAR ON PLASMA PHYSICS, LIBLICE, MAY 10–12, 1972. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Aug 1972. 105p. (CONF-720588-).

Twenty-three papers presented at the seminar are included. The papers cover a wide range of studies dealing mainly with basic plasma research. (MOW)

19855 ION-NEUTRAL COLLISIONS AND THE ION SOUND WAVE. Virmont, J. (Ecole Polytechnique, Paris). Plasma Phys.; 16: No. 2, 201-221(Feb 1974).

Ion–neutral collisions can be taken into account in the (linearized) ion kinetic equation by the Boltzman collision operator K. Gross and Jackson (Gross, E. P. and Jackson, E. A., Phys. Fluids, 2: 432 (1959), have shown that K can be approximated convergently by simple operators K_N (N = 0, 1, 2 ...), K_N preserving the N first eigenvalues of K and approximating the others by a single constant λ. An approximation scheme for a specific application is discussed: the computation of the complex wave-number k(ω) of the ion sound wave. For this, the eigenvalues of K are evaluated for the elastic ion–neutral interaction, the best choice of λ is determined, and the convergence of the approximations is considered. It is shown that N = 3 leads to an error smaller than 2%. The properties of the ion sound wave (phase velocity and damping) at frequencies about the ion neutral collision frequency, where simpler models fail and where the transition from collisional to Landau damping occurs, are described. (auth)

19856 DEVELOPMENT OF HIGH-TEMPERATURE PLASMA PHYSICS IN THE LAST DECADE. Hamberger, S. M. (Culham Lab., Abingdon, Eng.). Contemp. Phys.; 14: No. 6, 559-573 (Nov 1973).

The behavior of plasma may be considered at quite different levels, e.g., as a conducting fluid, as a reacting system of gases, or as a large assembly of charged particles. This review attempts to outline in broad terms the way in which the understanding of plasma, especially in the third sense, has increased in the last 10 to 15 years from an essentially qualitative level to one in which at least some of its behavior can be predicted quantitatively with confidence. This has come about, largely from the needs of fusion research, by a worldwide effort aimed at improving both theoretical models and experimental (especially diagnostic) techniques. As a result, one now has a good understanding of the properties of plasma in equilibrium and its response to small-amplitude perturbation; the main effort is now devoted to extending this to its nonlinear behavior, which is particularly important since plasma has so many available modes of vibration as well as a dual particle-continuum nature peculiar to that state. (auth)

19857 STUDY OF THE DEIONIZATION OF A PULSE DISCHARGE PLASMA IN A INHOMOGENEOUS, HIGH-FREQUENCY FIELD. Bilous, V. V. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 132-135(1972). (In Russian).

A study was carried out on the effect of an inhomogeneous high-frequency (70 kHz) field, created by a system of axial rings, on the time of deionization of a pulse-discharge plasma which was excited in a glass-discharge tube having an outer diameter of 3.5 cm at a pressure $p \sim 6 \times 10^{-2}$ to 1 torr. The high-frequency field causes a contraction of the plasma during its breakdown, and increases the deionization time many fold. The greatest effect of the high-frequency field is observed at low pressures. The rate of plasma deionization during its collapse in a high-frequency field, starting from some moment of time, decreases sharply. (tr-auth)

19858 YAVLENIYA PERENOSA V TERMICHESKOI PLAZME. (Transfer Phenomena in a Hot Plasma). Anderson, D. E. Moscow; Energiya (1972). 151p.

Questions of magnetogasdynamics as applied to hot arc-discharge plasmas were discussed. General questions relative to the regularities, peculiar to hot plasmas, are then considered. A theoretical investigation of the behavior of electric arcs during their interaction with gas flow and magnetic fields is reported. (tr-auth)

19859 DYNAMICS OF STEP HEAT WAVES IN GASES AND PLASMAS. Ahlborn, B. (Univ. of British Columbia, Vancouver); Strachan, J. D. Can. J. Phys.; 51: No. 13, 1416-1427(1 Jul 1973).

General properties of step heat waves are explained using the "response plane" which has axes of final enthalpy and absorbed power. As examples of heat waves, the time development of ionizing radiation fronts in interstellar H II clouds is discussed. The description is given of chemical reactions in the response plane and the pv diagram. The operation conditions of steady fusion reactions is given. The time history of decaying laser sparks is discussed. Possibilities of thermonuclear fusion with lasers are surveyed. All such heat waves exhibit similar fluid behavior since these phenomena occur due to the absorption of some energy into the ambient medium. (auth)

19860 INVESTIGATION OF THE MECHANISM OF EXCITATION OF STOCHASTIC OSCILLATIONS IN A BEAM–PLASMA DISCHARGE. Lavrovskii, V. A.; Kharchenko, I. F.; Shustin, E. G. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2236-2249(Dec 1973). (In Russian).

The structure of high-frequency oscillations and the velocity distribution function for the beam electrons in a beam–plasma discharge in a magnetic field are investigated. The causes of the discrepancy between the experimental results and predictions of the nonlinear theory of interaction between the beam and plasma are elucidated. It is shown that the instability characteristics measured over short time periods are in agreement with the theoretical predictions. The structure of the high-frequency oscillations excited in the discharge indicate that the beam interacts with a finite number of discrete plasma oscillation modes randomly alternating in time. The instantaneous electron distribution function is a complex multi-peak curve. It is found that stochastization of the oscillations is due to development of instability by trapped particles in the nonlinear stage of beam instability. (auth)

19861 COLLECTIVE INTERACTION BETWEEN A MONOENERGETIC BEAM AND PLASMA LAYER. Kalmykova, S. S. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2250-2260(Dec 1973). (In Russian).

The stability of a monoenergetic beam of electrons, which are continuously injected into a plasma layer whose thickness is small compared with the beam relaxation length in an infinite plasma, is investigated theoretically. The problem of determining the proper oscillation spectra of the system is reduced to that of solving a transcendental equation with coefficients defined by the proper wave

transformation tensors at the entrance and exit boundaries of the layer. The tensors are calculated analytically by solving the field integral equations in the corresponding half-spaces. Thus, the familiar Landau results have been extended to the case of a nonequilibrium plasma. Analytic solutions are obtained for the spectra. The excited frequencies and increments are found in the limiting cases of large and small differences between the beam velocity and phase velocity of the plasma waves in the layer. Some physical mechanisms underlying the instability under consideration are discussed. (auth)

Kinetics (Experimental)

Refer also to abstract 19897.

19862 (NP-19927) EXPERIMENTAL INVESTIGATION OF INTERACTION PROCESSES OF INTENSE RELATIVISTIC ELECTRON FLOW IN A BEAM–PLASMA SYSTEM. Gosteva, T. S.; Zablotskaya, G. R.; Ivanov, B. A.; Chernobrovin, V. I. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The experiments were carried out using a high-current electron accelerator. The relativistic electron flow with a bunch energy of ~1 kJ, a maximum current value of 50 kA, and pulse duration of ~20 nsec was used in the experiment. (auth)

Kinetics (Theoretical)

Refer also to abstracts 19409 and 19487.

19863 (CEA-R-4497) BROADENING OF ATOMIC ABSORPTION LINES IN A PLASMA. Penicaud, M. (CEA Centre d'Etudes de Limeil, 94–Villeneuve-Saint-Georges (France)). Jan 1974. 70p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Paris Univ. (France).

A theory is presented using double-time, statistical Green functions where the full dynamical picture of all particle interactions is naturally incorporated. Doppler broadening appears automatically in the theory. The line profile for Lyman-α absorption is calculated via linear response theory. Interaction between the radiating atom and the perturber is treated without approximations. The calculated line profile is compared with the experimental data of Griem and Elton and it is seen that the behavior near the line center is fairly well reproduced. Broadening due to electrons alone is compared with the theory of Zaidi and some differences are noted. Further, a slight fluctuation of the line profile appears at a frequency separation from the line center equal to the electron plasma frequency. (auth)

19864 (CLM-R-118) DATA ORGANIZATION FOR 3-DIMENSIONAL CALCULATIONS ON THE IBM 360/91 USING HIGH-SPEED DRUM TRANSFERS. Kuo-Petravic, G.; Petravic, M.; Roberts, K. V. (UKAEA Research Group, Abingdon, Culham Lab.). Sep 1973. 60p. Dep. NTIS (U. S. Sales Only) $5.00. UK pounds1.

Mesh calculations in three dimensions in hydrodynamics, magnetohydrodynamics, plasma physics and other fields of classical computational physics require that several Mbytes of fast scratch storage should be available to hold the physical variables that must be updated each timestep. This report discusses the general principles that govern the data organization for such calculations, and describes a subroutine TRANSF which uses the EXCP macro to transfer data between the main store of the IBM 360/91 and two IBM 2301 drums in synchronism with the physical calculation, thus securing efficient CPU utilization. An initialization subroutine SETDRM is also described. Both subroutines can be called from Fortran. The listings have been carefully documented, together with page references to the relevant IBM manuals, and program commentaries and indexes are also provided. (auth)

19865 (COO-2230-1, pp 3a.1-3a.33) STRAIGHT AND TOROIDAL PLASMA EQUILIBRIA WITH AN INTENSE RELATIVISTIC ELECTRON CURRENT COMPONENT. Mondelli, A.; Ott, E. May 1973.

In plasma heating and confinement at high temperatures.

The equilibrium of an axisymmetric, large-aspect-ratio, finite-temperature toroidal plasma enclosed by a perfectly conducting toroidal container is investigated. The new feature of the analysis is the presence of a relativistic electron beam which circulates around the torus thus producing a poloidal magnetic field in addition to the external field and the field created by currents in the plasma. This problem may be of interest in connection with recent toroidal beam injection experiments at Cornell University and tokamaks. The equilibria are obtained from the relativistic virial theorem. Specific examples are given wherein the plasma pressure is characterized by its dependence on the magnetic flux function and the relativistic electron beam is characterized by an electron distribution function which is a delta function in energy and canonical momentum in the toroidal direction. (auth)

19866 (COO-2230-1, pp 3b.1-3b.16) SYNCHROTRON RADIATION FROM FORCE-FREE EQUILIBRIA. Mondelli, A. A.; Yoshikawa, S. Jan 1973.

In plasma heating and confinement at high temperatures.

The synchrotron radiation losses from relativistic electron beams which are close to a force-free configuration are examined. The resulting radiation is found to be substantially less than the radiation found from a nonforce-free configuration, such as the well-known Hammer–Rostoker equilibrium. It is concluded that force-free beams may therefore be useful for providing magnetic confinement of plasma. (auth)

19867 THEORY OF AN OPEN RESONATOR FILLED WITH A MOVING PLASMA. Kalmikova, S. S.; Slyusars'kii, V. A.; Bakhtin, V. D. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 108-112(1972). (In Russian).

A homogeneous plasma moves along the axis of an open waveguide in such a manner that after exiting from the waveguide, the velocity, concentration, and dimensions of the plasma remain unchanged. Expressions are given for the spectrum of frequencies and the width of the spectral lines from the open resonator. It is shown that the movement has a substantial effect on the frequency characteristics of the resonator during application of a strong magnetic field. (tr-auth)

19868 KINETIC EQUATION AND THE EQUATION OF MOMENTUM TRANSFER FOR A PLASMA. Majumdar, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Pramana; 1: No. 3, 129-134 (Sep 1973).

An attempt is made to derive a simple form of the collision integral of the kinetic equation for a plasma by using Rostoker's equation, which expresses the pair correlation function in terms of the distribution functions of the particles and the conditional probability of one particle shielding the other. The conditional probability function is assumed to be given by its equilibrium value. By taking first-order velocity moments of the resulting kinetic equation, the equation of momentum transfer is obtained. (auth)

19869 EXACT SOLUTIONS OF THE BOLTZMANN KINETIC EQUATION FOR LORENTZ PLASMA. Zima, T. E.; Kostritsa, A. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 6-10 (1973). (In Russian).

A method for obtaining the moments of exact functions, satisfying the nonstationary transfer equation for electrons, was illustrated for cases when the scattering cross section changes according to the 1/v law. The deviation of the distribution of the electron velocity from the Maxwell distribution was discussed. (tr-auth)

19870 TRANSITION PROCESSES IN LORENTZ PLASMA. Kostritsa, A. A.; Saichenko, S. Yu. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.,-Mat.; No. 2, 78-80(1973). (In Russian).

On the basis of an exact solution of the Boltzmann equation for a Lorentz plasma, the dependence of the energy of the electron gas on the time in the alternating electrical field was examined. The scattering cross section was assumed to obey the 1/v law. (tr-auth)

Production

19871 SUPERSONIC DISCHARGE OF PLASMA FROM A ROTATING SOURCE. Shabanskii, V. P.; Shister, A. R. (Scientific Research Inst. of Nuclear Physics, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 4, 825-828(1 Aug 1973). (In Russian).

Calculations are presented which show that problems of radial emission of particles from the surface of a rotating sphere under definite conditions leads to a unidimensional equation for the rate, and other properties of the plasma are determined from similar equations. (MWG)

19872 STIMULATED EMISSION OF X RAYS FROM PLASMAS GENERATED BY SHORT-PULSE LASER HEATING OF SOLID TARGETS. Jha, S. S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 1: No. 2, 88-97(Aug 1973).

The problem of heating of a solid target to generate a nonequilibrium plasma by subnanosecond laser pulses is considered. For an appreciable absorption of energy from a Nd-glass laser, the critical density of the electrons in the plasma turns out to be 10^{21} cm^{-3}. These electrons can be heated up to 10^7 K or more by using pulses of about 10 picosecond duration and absorbed energy flux of the order of 10^{21} erg cm^{-2} sec^{-1}. Starting from neutral atoms in a solid with a high atomic number, e.g., Z = 26, for

times in the picosecond regime the relevant rate equations are solved analytically to predict densities of the atoms at different ionization levels. It is shown that during such a short time the population density of the ions isoelectronic to neon builds up to a very large amount. This in turn leads to the population inversion in the 4s → 3p soft x-ray laser transition, via the electron-impact excitation of the 4s level of the isoelectronic neon ion. For the effective pumping times of the order of 5 picoseconds, a gain of the order of 10^2 db cm^{-1} is predicted for the laser transition in Fe XVII, Co XVIII or Cu XX. (auth)

Stability

Refer also to abstract 19844.

19873 (JAERI-M-5263) EXPERIMENTAL OBSERVATION OF COLLISIONLESS DRIFT WAVES IN THE JAERI TOROIDAL HEXAPOLE (JFT-1). Nagashima, T.; Yamato, H.; Ohtsuka, H.; Shiina, T.; Tamura, S. (Japan Atomic Energy Research Inst., Tokyo). May 1973. 24p. NTIS (U. S. Sales Only).

An experimental study of low-frequency waves was made in a low-β plasma of the JAERI toroidal hexapole with and without toroidal field. The observed waves are identified as density-toroidal field. The observed waves are identified as density-gradient-driven collisionless drift waves and the interpretation of their mode transitions of poloidal mode number is given by comparison of the experimental results with the results predicted from the linear theory of a slab geometry. (auth)

19874 (ORNL-TM-4475) PROGRAM IPP6: MICROINSTABILITIES IN INHOMOGENEOUS, MIRROR-CONTAINED PLASMAS. Beasley, C. O. Jr.; Hicks, H. R. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 69p. Dep. NTIS $5.50.

A description of the program IPP6, the program for finding unstable loss-cone modes in a model mirror-contained plasma, is given. The input data are described, the output is explained, and the internal workings of the various subprograms are given. Connection is made with the previously published analytical derivation of equations used in formulating the model. (auth)

19875 STABILIZATION OF DRIFT-DISSIPATIVE INSTABILITY BY MAGNETIC-ACOUSTIC WAVE. Soboleva, T. K. Dokl. Akad. Nauk SSSR; 211: No. 4, 818-820(1 Aug 1973). (In Russian).

Calculations showed that drift-dissipative instabilities may be stabilized by a high-frequency magneto-acoustic wave. The criterion of stabilization is somewhat more rigid than for a collisionless plasma, but the proposed method of stabilization may be more efficient than the method using a high-frequency electric field. (TTT)

19876 NONLINEAR SATURATION OF ION-ACOUSTIC INSTABILITY. Krishan, V.; Krishan, S. (Inst. of Science, Bangalore, India). Plasma Phys.; 16: No. 2, 153-160(Feb 1974).

It was proposed that the wave-mediated indirect wave–particle interaction may be responsible for nonlinear saturation of current-driven low-frequency ion-acoustic turbulence. This process decreased the growth rate and increased the damping rate of the wave. Comparison was made with some experiments. (auth)

19877 QUASI-TRAPPED PARTICLE ORBITS DUE TO TOROIDAL PLASMA MODES. Coppi, B. (Inst. of Tech., Cambridge, MA); Taroni, A. Plasma Phys.; 16: No. 2, 161-187 (Feb 1974).

A combined numerical and analytical treatment of the particle orbits in a two-dimensional toroidal configuration is given by analyzing the resonant effects of a special class of electrostatic standing modes such as those that can result from plasma micro-instabilities. It is shown that trapped-particle orbits with bounce frequencies close to the considered mode frequency could be significantly amplified and even untrapped for reasonable mode amplitudes. The radial width of the resulting orbits which remain trapped ("quasi-bananas") could be significantly larger than that of the known bananas with their centers being displaced from the magnetic surface on which the considered modes were excited. The orbits of particles, which in the absence of fluctuations are weakly trapped or barely circulating, are replaced by a new class of orbits with nonvanishing bounce frequencies, which were alternatively trapped and circulating ("quasi-circulating"). The change on the average displacement of a particle orbit from a given magnetic line over a typical orbit time is evaluated in view of its importance for the stability of (low frequency) interchange trapped-particle modes. (auth)

19878 CLASSIFICATION AND STABILITY OF DOUBLE WATER-BAG PLASMA EQUILIBRIA. Finzi, U. (CEN, Grenoble, France); Doremus, J. P.; Holec, J.; Feix, M. R. Plasma Phys.; 16: No. 2, 189-200(Feb 1974).

The stationary states of a one-dimensional system formed by a double Water-Bag electron distribution and a fixed homogeneous ion background are discussed. Conditions for the existence of periodic and aperiodic equilibria are calculated. The stability of aperiodic solutions is investigated by a perturbative technique already used for a similar gravitational problem. A sufficient condition for stability is found to be $\tau_1 > \tau_2$ (τ_1 and τ_2 being the periods of rotation of electrons on the inner and outer contour, respectively). A sufficient condition for instability, derived from a thermodynamic theory, is found to be in agreement with the results of the perturbative analysis. (auth)

19879 UNSTABLE FLUTE-LIKE CYCLOTRON MODES CAUSED BY THE PRESENCE OF SUPRATHERMAL PARTICLES IN A MAGNETOPLASMA. Teichmann, J.; Van Andel, H. W. H. (Univ. of Montreal). Can. J. Phys.; 51: No. 11, 1123-1134(1 Jun 1973).

The stability of a cold magnetoplasma containing an isotropic distribution of suprathermal electrons or ions is studied. It is found that such a plasma is unstable for cyclotron harmonic modes for certain choices of the plasma parameters. Particle density gradients enhance the instability for modes propagating in the direction of the particle drifts. A finite plasma temperature as well as energy spreading of the suprathermal particles have a stabilizing effect on the instability. (auth)

19880 THERMAL EFFECTS ON THE ELECTROMAGNETIC INSTABILITY IN A COUNTERSTREAMING ELECTRON PLASMA. Seshadri, S. R. (Univ. of Wisconsin, Madison). Can. J. Phys.; 51: No. 14, 1508-1518(15 Jul 1973).

The thermal effects on the characteristics of the instability of a plane electromagnetic wave propagating obliquely to a counter-streaming electron plasma are investigated using a simple velocity distribution for the electrons. For all directions of the wave vector unstable waves exist for wavenumbers below a cutoff value. The velocity distribution of the electrons is found to reduce the cutoff wavenumber and the growth rate, and this reduction is seen to increase as the wave vector is further removed from the direction of the streams. In contrast to a zero-temperature plasma, the thermal effects quench the instability for all directions of the wave vector with respect to the counterstreaming plasma for wavenumbers above a certain maximum value which is inversely proportional to the average thermal velocity. Also, the dependence of the growth rate on the stream direction with respect to the wave vector is examined for various values of the wavenumber. The velocity distribution of the electrons decreases the growth rate and this inhibiting influence increases with increasing values of the wavenumber. In addition, unlike in the case of a zero-temperature plasma, the quasi-static assumption is found to be inapplicable for predicting the characteristics of the instability except for the case in which the wave vector is very nearly parallel to the direction of the streams. (auth)

19881 DRIFT OSCILLATIONS OF AN INHOMOGENEOUS PLASMA IN A QUANTIZED MAGNETIC FIELD. Kolesov, V. V. (Ural State Univ., Sverdlovsk, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 6, 2217-2224(Dec 1973). (In Russian).

Quantum theory of the electric conductivity tensor is employed in an investigation of drift oscillations of an inhomogeneous plasma in a quantized magnetic field. Additional drift-oscillation branches are found that are due to the quantum nature of the carrier orbital motion. Both potential and nonpotential quantum drift oscillations, transparency regions, and stability conditions are investigated in detail. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 19596 and 20404.

19882 (IPP-4-111) NEODYMIUM LIQUID LASER: CONSTRUCTION, PROPERTIES, AND SCATTERING IN THE ACTIVE MEDIUM. Lang, R. S. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 74p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

The construction of a neodymium liquid laser with circulating liquid is described. The properties of the laser were studied. In the free running mode of the laser the cross section for the stimulated emission σ was measured. In the same mode, the comparison of theory and experiment shows backscattering. The especially long laser cell lowers the thresholds for stimulated scattering effects to power densities occurring in the actively Q-switched laser. Stimu-

lated Raman and Brillouin scattering has thus been detected. In order to demonstrate Brillouin scattering, the necessary line-narrowing of the laser emission was produced by a pilot oscillator with small bandwidth. The experimental arrangement allowed the laser output characteristics to be studied at three different bandwidths. (auth)

19883 (UCRL-75249) DESIGN STUDIES OF MIRROR MACHINE REACTORS. Werner, R. W.; Carlson, G. A.; Hovingh, J.; Lee, J. D.; Peterson, M. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1973. 12p. Dep. NTIS $3.00.

An overview is presented of a mirror fusion reactor design study. The general methodology used in the study is discussed, the reactor is described, and some design alternatives to the present approach are enumerated. The system chosen for this design study is a mirror machine with direct conversion using D–T fuel. The nominal power output is 200 MW. The coil geometry is the Yin Yang, minimum |B| with a vacuum mirror ratio of 3. The coil is of particular utility because of its simple conductor shapes and because the two separate conductors, by proper B-field biasing, allow the charged particles to escape preferentially through one mirror only and through a relatively small "window" of that mirror. This is necessary for direct converter economy. (auth)

19884 LASERS OF THE SECOND DECADE: CHARACTERISTICS AND APPLICATIONS OF POWER LASERS. Arecchi, F. T. (Univ., Pavia, Italy); Poletti, G. Elettrotecnica; 60: No. 5, 1-37 (1973). (In Italian).

A critical review of high-power lasers developed in the last several years is presented. The pumping systems, efficiency, and performance of these lasers are discussed. Among the possible applications, particular attention is given to the possibility of their use in controlled thermonuclear fusion. As an introduction, the physical concepts and the basic techniques of lasers are discussed. (tr-auth)

19885 FUSION REACTORS: THE ULTIMATE SOLUTION. Kenward, M. New Sci.; No. 60, 896-899(27 Dec 1973).

Fusion power is an extremely promising prospect as an energy source from the 21st century onwards, since the resources of the raw materials required are enormous. The deuterium–tritium (DT) reaction will probably fuel the first fusion reactors and thus the nature of this reaction will determine many of the characteristics of a fusion reactor; some of these are listed. The question of the containment system is discussed. Problem areas found by reactor specialists are examined and it is noted that environmental considerations are being examined from the outset. (UK)

19886 STUDY OF THE ION BEAM INTENSITY AND DIVERGENCE OBTAINED FROM A SINGLE APERTURE THREE-ELECTRODE EXTRACTION SYSTEM. Coupland, J. R.; Green, T. S.; Hammond, D. P.; Riviere, A. C. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Rev. Sci. Instrum.; 44: No. 9, 1258-1270(Sep 1973).

Experimental results are given for the perveance and beam divergence of a single-aperture three-electrode extraction system using helium ions at energies between 10 and 30 keV. The aperture radii, the electrode thicknesses, and the spacings were varied and, from the results, a preferred design was obtained for use in a multi-aperture array. The most critical parameter was the ratio (S) of the radius of the first aperture to the distance between the first and second electrodes, the highest current density being obtained at values of this ratio less than 0.5. The optimum beam divergence observed corresponded to a Gaussian beam profile with a width (ω) of $\pm$ 1.2° at 2 m from the source. The measured perveance at small values of S and at minimum ω lay between 75 and 90% of the value predicted on the basis of a simple model using the Langmuir–Blodgett formula for the spherical diode. (auth)

Wave Phenomena

Refer also to abstract 19855.

19887 SYMMETRIC WAVES IN A GYROTROPIC PLASMA SPHERE ON A LOGARITHMIC SPIRAL. Yatsuk, K. P.; Bikhovets, V. V.; Arsen'eva, S. I. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 30-34(1972). (In Russian).

Consideration is given to the propagation of radial waves in a system that consists of a logarithmic spiral and a plasma sphere. A magnetic field is applied at the wall perpendicular to the direction of propagation of the electromagnetic waves. The problem is resolved by a hydrodynamic approximation. A dispersion equation is obtained for the symmetric waves. Numerical calculation of the dispersion characteristics were carried out on a computer at various parameters of the system. It is shown that the dispersion characteristics of the spiral on the plasma sphere change only slightly, while the energy characteristics show a greater variation. (tr-auth)

19888 DETERMINING THE EXTINCTION OF ELECTROMAGNETIC WAVES IN PLASMA BUNDLES. Bakhtin, V. D.; Martinenko, L. G.; Nerukh, O. G.; Siyusars'kii, V. A. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 112-115(1972). (In Russian).

Experimental determinations were carried out on the extinction of electromagnetic waves having a frequency of 335 GHz in plasma bundles created by end jet erosion. It is shown that the wave extinction possesses an oscillatory character. Maximum extinction increases with increases of the discharge voltage and also of the initial pressure in the vacuum chamber. (tr-auth)

19889 EXPERIMENTAL STUDY OF PARTICULAR RADIATION OF A PLASMA IN A HOLLOW-CATHODE WAVEGUIDE. Latinin, Yu. M. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 115-118(1972). (In Russian).

A study was carried out on the dependence of the radiation flux in the frequency range of 8.9 to 9.8 GHz from a plasma in a hollow-cathode waveguide as a function of the change in plasma density. It is shown that the radiation flux from a plasma, which has a density lower than the critical density in the waveguide, depends on the matching of the electromagnetic waves, which radiate to the side opposite their reception. (tr-auth)

19890 EXPERIMENTAL STUDY OF A PLASMA IN A HOLLOW-CATHODE WAVEGUIDE PLACED IN AN EXTERIOR MAGNETIC FIELD. Karpov, Yu. M.; Latinin, Yu. M. Visn. Kharkiv. Univ., Radiofiz. Elektron.; No. 1, 118-120(1972). (In Russian).

The effect of longitudinal and radial magnetic fields on the 3-cm plasma radiation emission which occurs in a hollow cathode-waveguide was studied experimentally. On increasing the plasma concentration, the maximum of the radiation flux is displaced to the side of lesser tension of the longitudinal magnetic fields. The radial magnetic field has a substantial effect on the plasma concentration, its temperature, and the character of the radiation. (tr-auth)

19891 SCATTERING OF A STRONG WAVE BY PLASMA ELECTRONS. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). pp 281-289 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

An elementary derivation of the cross section of a strong wave on plasma electrons trapped in a longitudinal field is given. The real and imaginary parts of the refractive index are considered for a plasma consisting of such electrons. The conditions of electron trapping are considered. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 18440, 18616–18618, 18756–18766, 18770, 19361, and 19783.

19892 (CONF-730958-2) $Z^{\frac{1}{2}}$-DEPENDENT STOPPING POWER AND RANGE CONTRIBUTIONS. Ashley, J. C.; Ritchie, R. H.; Brandt, W. (Oak Ridge National Lab., Tenn. (USA); New York Univ., N. Y. (USA). Dept. of Physics). 1973. 14p. Dep. NTIS $3.00.

From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973).

The topics discussed are $Z^{\frac{1}{2}}$-dependent stopping power and range contributions and the influence of the $Z^{\frac{1}{2}}$ contribution to stopping power on the evaluation of mean excitation potentials and shell corrections. (MHR)

19893 (KFKI-73-64) RENORMALIZATION AND SCALING IN THE X-RAY ABSORPTION AND KONDO PROBLEMS. Solyom, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

The renormalization group method is extended in case of logarithmic problems to include the imaginary parts of Green's functions and vertices, which have been neglected in the earlier versions of the theory. The relation between multiplicative renormalization and scaling of the characteristic energy is demonstrated and is used to investigate the x-ray absorption and Kondo problems. The properly defined invariant couplings depend on a single variable, the scaling energy, and are real, as expected physically. The scaling laws are rederived on this more rigorous basis. It is shown that the imaginary parts of the Green's functions and vertices give no contribution to the scaling laws. In particular in the Kondo problem the scaling laws obtained earlier remain intact, indicating that in this improved theory as well the potential scattering is not renormalized and is not coupled to the exchange scattering. (auth)

19894 TRANSMISSION OF BETA PARTICLES IN DIELECTRICS IN THE PRESENCE OF AN ELECTRIC FIELD. Veretel'nik, V. I.; Gusel'nikov, V. N.; Evdokimov, O. B.; Kononov, B. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 113-118(1973). (In Russian).

The effect of an electric field on the transmission of β particles of ^{204}Tl through targets of polymethylmethacrylate, polystyrene, lavsan, and polyethylene was investigated. The number of transmitted β particles and the angular and energy distributions were measured. Measurement of the transmission curve was done with the SBT-7 counter; the angular distribution was studied in a specially developed scattering chamber; and the energy distribution was studied with a scintillation β spectrometer based on the USD-1 and the AI-100. It was established that the relative change of the number of transmitted β particles depends on the size of the incident solid angle, linearly depends on the potential difference applied to the dielectric, and practically is independent of the dielectric material if its thickness is expressed in mass units. It was also established that the relative change of the angular distribution up to 60° and potential differences no higher than 10 kv does not depend on the scattering angle; the energy distribution not only was displaced on the energy scale but changed form. The results were explained by the fact that the electric field affects both the particle energy and its pulse direction. A simple method was proposed for the calculation of the effect of the field on the number of transmitted β particles. The results of the calculation agree with experimental results. (tr-auth)

19895 CALCULATED AND MEASURED DOSE BUILDUP FACTORS FOR GAMMA RAYS PENETRATING MULTILAYERED SLABS. Burke, G. de P.; Beck, H. L. (Health and Safety Lab., New York). Nucl. Sci. Eng.; 53: No. 1, 109-112(Jan 1974).

Dose buildup factors for normally incident 662-keV gamma rays penetrating multilayered aluminum-lead slabs were measured for various combinations using thermoluminescence dosimeters. The results were compared with calculated values obtained from a gamma-ray transport code and with values inferred from a semi-empirical formula using single-layer slab buildup factors. This formula, a slightly modified version of the Kalos formula, predicts buildup factors in excellent agreement with both experiments and calculations, even for multilayered combinations. The formula also provides buildup factors which are in good agreement with transport calculations for other source energies and slab materials, indicating a probable wide range of validity. (auth)

19896 ELECTRON-CAPTURE AND LOSS CROSS SECTIONS FOR FAST, HEAVY PARTICLES PASSING THROUGH GASES. Lo, H. H.; Fite, W. L. (Univ. of Pittsburgh). At. Data; 1: No. 3, 305-328(May 1970).

Electron-capture and loss cross sections as functions of projectile velocity and energy are presented graphically for six gaseous and twelve metallic, fast, singly-charged ions (in some cases, neutral atoms and multiply-charged ions are also included) in collision with nitrogen, oxygen, neon, argon, and atomic oxygen. The lowest projectile energy is 30 eV, while the highest is 4 MeV. (auth)

19897 PLASMA OSCILLATIONS IN Al, Mg, Li, Na, AND K EXCITED BY FAST ELECTRONS. Kloos, T. (Univ., Hamburg). Z. Phys.; 265: No. 3, 225-238(Nov 1973).

Energy loss experiments with 50-keV electrons transmitted through thin films of the metals Al, Mg, Li, Na, and K are reported. The valence electrons of these materials behave like a gas of free electrons to a good approximation and, in particular, give rise to significant collective effects. Since these substances oxidize rapidly they were evaporated and studied in ultra high vacuum. The apparatus and the measurement technique are described. Measurements of loss spectra for different electron scattering angles yield the volume plasmon dispersion curve and the dependence of the damping of the volume plasmon on the wave vector. New experimental values of the energy and the half width of the plasma oscillations and the coefficients of dispersion and damping are given. In addition, the results of some measurements on surface plasmons are presented. There are significant deviations from the predictions of the simple electron gas model. (auth)

19898 HEAVY ION RANGES AT 100 keV IN ALUMINIUM. Neilson, G. W.; Farmery, B. W.; Thompson, M. W. (Univ. of Sussex, Eng.). Phys. Lett.; 46A: No. 1, 45-46(19 Nov 1973).

A systematic study of the range of heavy ions ($M_1 > 130$) in aluminum ($M_1 = 27$) has been initiated and this letter reports some interesting preliminary findings. (auth)

19899 EVALUATION OF DOSE DISTRIBUTION IN MATERIALS IRRADIATED WITH ELECTRONS IN THE ENERGY RANGE FROM 10 TO 25 MeV. Vainer, E. A.; Balitskii, V. A.; Bochkarev, V. V.; Radzievskii, G. B. pp 24-29 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A method is proposed for the evaluation of the dose field created by electron beams. It is based on the use of empirical transmission curves. With use of the simple empirical relations for the mean value of the electron energy in the direct and reverse beams and the stopping power for these energies a relation was established between the dose distribution and the transmission curve. The calculations agree satisfactorily with experimental data. (tr-auth)

19900 ABSORBED-DOSE-FIELD DISTRIBUTION DURING IRRADIATION OF FLAT AND CYLINDRICAL OBJECTS (e.g., POLYETHYLENE) WITH A POLYCHROMATIC ELECTRON BEAM OF HIGH-CURRENT ACCELERATORS OF ELT-1.5 AND ELT-2.5 TYPES. Abramov, K. K.; Braginskii, R. P.; Kovalev, G. P.; Polyakov, A. A.; Finkel, E. E.; Fridman, V. I. pp 36-45 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The electron energy distribution was determined as a function of the beam parameters on the basis of experiments on the attenuation of the electron beam current passing through metallic filters. It was shown that for monoenergetic electron beams the distribution of the absorbed dose rate with respect to the thickness of the absorber during its irradiation with a polychromatic electron beam (ELT-1.5) is almost independent of the maximum beam energy. The evaluation of the accuracy of the method proposed for the calculation of the absorbed dose rate field was made by comparison with experiments on the irradiation of flat polyethylene samples. The experimental results agree satisfactorily with the calculations. The absorbed dose distribution in the volume of cylindrical polyethylene insulators was calculated for assemblies of conductors with radius of the core from 0.15 to 3.0 mm and radial thickness of the insulator from 0.15 to 1.2 mm at different operating regimes of the accelerator. It was shown that with some combinations of the characteristics of the electron beam on the one hand and geometric dimensions of the irradiated conductor on the other hand the degree of irregularity of the absorbed dose rate field does not depend on the thickness of the insulator. This method

of calculation makes it possible to establish an optimum regime for the irradiation of conductors of different cross section with different thickness of the insulator at a previously given degree of irregularity of the absorbed dose field. (tr-auth)

19901 DISTRIBUTION OF ENERGY LOST BY FAST ELECTRONS IN DIELECTRICS WITH HOMOGENEOUS ELECTRIC FIELD. Vorob'ev, A. A.; Evdokimov, O. B.; Ryzhakova, N. K. pp 45-52 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A method was described for the calculation of the differential electron current in a homogenous electric field and of the distribution of the energy lost. An expression was obtained for the energy loss distribution and stopped electron distribution according to the depth. The electron moderation spectrum in the presence of an electric field was determined with consideration of the multiplication. The effect of the electrical field was achieved because of the fast component of the spectrum. (tr-auth)

19902 EFFECT OF BEAM CURRENT ON ELECTRON MEAN FREE PATH IN DIELECTRICS. Evdokomov, O. B.; Tubalov, N. P. pp 52-54 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The results of the measurement of the extrapolated mean free path of electrons with energy from 0.8 to 1.2 MeV in plastic, polystyrene, and rigid PVC plastic at beam currents of 5×10^{-9} to 5×10^{-4} amp are reported. It was established that the electron mean free path is determined by the beam current and depends on the electric properties of the dielectric and on the surface potential. (tr-auth)

19903 LOW-ENERGY COMPONENT OF SPECTRUM OF ELECTRON RADIATION FIELD NEAR THE EXTRAPOLATED MEAN FREE PATH. Kononov, B. A.; Gusev, E. A.; Evstigneev, V. V.; Boiko, V. I. pp 54-57 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The low-energy component of the spectrum of the peripheral region of the spectral distribution of electrons passing through samples of C, Mg, Cu, and Pb with a thickness of 0.7 to 0.9 of the extrapolated mean free path was studied. The experimental analysis of the electron spectrum was done with an iron-free spectrometer with transverse magnetic field. It was shown that in the slowing down process of the incident beam accumulation of the low-energy electrons in the range from 400 to 1600 keV occurs. The low-energy electron spectrum is the most intense for Pb. With decrease of the atomic number of the target its low-energy electron spectrum decreases. (tr-auth)

19904 DETERMINATION OF SPECTRAL COMPOSITION AND ABSORBED ENERGY OF GAMMA RADIATION FROM VOLUME SOURCES. Drozdov, V. E.; Dunaev, L. M.; Novgorodtsev, R. B.; Lisov, G. N. pp 84-92 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

A relatively simple and universal method for the numerical calculation of the absorbed energy in sources of any geometry with consideration of the non-uniform distribution of the activity is proposed. The method is based on the use of data on the absorbed energy of point sources placed on the axis of a cylinder. By use of the additive rule these data can be used for the calculation of absorbed energy in all practical cases with consideration of the presence of the casing and other construction elements of the irradiator. Some results of the calculation of the absorbed energy in sources of different geometry are reported. Some results of the calculation of the spectral composition of the radiation of cylindrical sources of water and iron at energies of 0.5, 1, and 3 MeV are also reported. The calculation and experimental data were compared with respect to the spectral composition of the γ radiation. Satisfactory agreement was obtained. (tr-auth)

19905 EFFECT OF ELASTIC SCATTERING OF RECOIL ELECTRONS AT THE BOUNDARY OF THE MEDIUM DURING GAMMA IRRADIATION. Antsilevich, M. G.; Lenchenko, V. M.; Sofienko, L. A. pp 93-95 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

For γ irradiated heterogeneous media, the curve shape of the increase of the optical density, caused by the displacement of the atoms during angular scattering of recoil electrons on the nucleus, was calculated. It was shown that the curve shape is qualitatively identical with the curve shape of the ionization near the flat boundary calculated according to the same medium parameters. (tr-auth)

19906 EXPERIMENTAL DETERMINATION OF RADIATIVE ENERGY RELEASE IN SOME CONSTRUCTION MATERIALS. Abdullaev, R. S.; Gurvich, L. G.; Zakharov, G. E.; Polyak, Yu. V.; Skripnikov, Yu. S. pp 197-200 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The results of the study of the stationary temperature distribution according to the thickness of a sphere placed in a reactor radiation field are reported. The specific heat release for different metals (steel, Al, Cu, Pb, and Cd) were found. The calculation of the specific heat release was made in the approximation of uniform and exponential distribution of the heat release sources according to the depth of the material. The measurement of the temperature field within the sphere made it possible to obtain data on the absorption of γ radiation in Pb. (tr-auth)

19907 RESULTS OF COMPLEX STUDY OF ENERGY RELEASE IN THE SM-2 REACTOR. Neverov, V. A.; Tsykanov, V. A. pp 200-206 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

The "base" values of the energy release in experimental installations during reactor operation were measured for a specific set of materials (according to thickness and Z) and a specified configuration of the active zone. The results of these same values calculated on the computer are reported. The contribution of the neutron component in the energy release of a series of irradiated construction materials was determined. (tr-auth)

19908 EXPERIMENTAL DETERMINATION OF IRRADIATION CONDITIONS WITH MINIMUM EXPENDITURE OF REACTOR TIME. Neverov, V. A.; Samsonov, B. V. pp 206-210 of Dozimetriya i Radiatsionnye Protsessy v Dozimetricheskikh Sistemakh. Blaunshtein, I. M. (Ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1972). (In Russian).

Using the SM-2 and MIR reactors as examples it was shown that on the basis of the "base" values of the energy release in one of the materials (Ni or Cu) and during one of the states of the reactor system the irradiation conditions of other installations with a minimum expenditure of time can be calculated and predicted with a specified degree of accuracy. (tr-auth)

19909 COMPUTATION OF THE GOUDSMIT-SAUNDERSON DISTRIBUTION IN ELECTRON TRANSPORT. Vande Putte, D. W. (Atomic Energy Board, Pretoria). Nucl. Instrum. Methods; 115: No. 1, 117-120(1974).

Equations leading to the Goudsmit-Saunderson electron multiple scattering distribution are examined from a numerical point of view. Shorter methods are proposed for their solution. (3 tables) (auth)

19910 RANGE AND ENERGY LOSS RATE FOR HEAVY IONS IN MAKROFOL AND CELLULOSE NITRATE. Tripier, J. (CEN, Strasbourg); Remy, G.; Ralarosy, J.; Debeauvais, M.; Stein, R.; Huss, D. Nucl. Instrum. Methods; 115: No. 1, 29-46(1974).

The range R, in Makrofol and cellulose nitrate, for a heavy ion with mass M, atomic number Z and velocity βc has been expressed by the semi-empirical formula: $R(\beta) = (M/Z^2)\, B_\alpha(\beta) + MZ^n C_z(137\,\beta/Z)$, where $n = 0.678 - 0.002\,Z$; $B_\alpha(\beta)$ is the referential range of an α particle at the same velocity as the ion, $C_z(137\,\beta/Z)$ is an empirical function that is a part of the expression of the extension in range caused by neutralization of the ionic charge near the stopping end of the trajectory. Both functions B_α and C_z were determined experimentally by means of semiconductor detectors. The energy loss rate was obtained by differentiating $R(\beta)$. We give range and energy loss values for several ions with energies up to 12 MeV/amu. (auth)

Radiation Protection Standards

Refer also to abstracts 18605, 20490, and 20494.

19911 (NP-19908) RADIATION PROTECTION STANDARDS FOR GASEOUS TRITIUM LIGHT DEVICES. (Organization for Economic Co-Operation and Development, Paris (France)). 1973. 22p.

The following subjects are covered: definitions of terms used, scope, principal considerations, requirements for manufacturing gaseous tritium light devices (GTLDs), requirements for the import of GTLDs, requirements for use of GTLDs, marking and labelling, recommendations concerning administrative control procedures, surveillance, prototype tests, radiation protection considerations, and technical data on gaseous tritium light sources. (MHR)

19912 NEW X-RAY ORDINANCE. Rieger, H. J. Deut. Med. Wochenschr.; 98: No. 35, 1632-1634(Aug 1973). (In German).

A brief outline is given of the new regulations concerning the licensing of the operation of x-ray devices, the protection of the personnel and the application of x-rays in the therapeutic treatment of patients. (GE)

Radiation Source Calibration and Standardization

Refer also to abstract 18083.

19913 SECONDARY GAMMA RADIATION IN A COLLIMATED BEAM FROM A ^{60}Co SOURCE. Tyurin, E. G.; Klimchuk, V. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 4, 1045-1046 (1973).

Translated from Prib. Tekh. Eksp.; 16: No. 4, 554-56(1973).

The contribution of secondary γ radiation to the resultant spectrum of a collimated beam from a ^{60}Co source at various distances from the collimation section of a UPGD-1M installation was measured. The measurements were carried out by means of a scintillation γ spectrometer with a NaI(Tl) crystal having the dimensions 30 × 30 mm^2, and with a NTA-512M multichannel amplitude analyzer. The contribution of the secondary radiation to the range corresponding to low energies exceeds 30%. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 20076, 20108, 20110, and 20264.

19914 (KFK-1869) ATTOW-K: THE KARLSRUHE IBM360/65-VERSION OF THE 2d REMOVAL DIFFUSION SHIELDING CODE ATTØW. Boenisch, G.; Wiese, H. W. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Oct 1973. 127p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

The IBM 7090-version of the removal-diffusion shielding code ATTØW for two-dimensional geometry (x,y or r,z) was converted for the Karlsruhe IBM 360/65-370/165 computer. The new version can utilize Karlsruhe multigroup constant sets either already in core storage or from external storage. Furthermore the SABINE removal cross section library was built in. The input description has been partly reformulated and augmented by additional explanations. (auth)

19915 DETERMINATION AND ANGLE-DEPENDENT ENERGY SPECTRA OF SCATTERED GAMMA RADIATION USING THE TRANSMISSION MATRIX METHOD. Winkler, B. Frankfurt am Main; Univ. Frankfurt am Main (1971). 68p. (In German). Thesis.

Gamma spectra for large shielding assemblies are determined. Energy spectra are obtained by a combination of Monte Carlo calculations with the transmission matrix method. From the calculated spectra, the buildup factors can be derived which are in good agreement with values calculated otherwise. (GE)

19916 BUILD-UP FACTORS FOR 14.1-MeV NEUTRONS IN DIFFERENT MATERIALS. Deimel, E.; Deimel, P. (Oesterreichische Hochschule, Vienna). Kerntechnik; 15: No. 10, 414-467(Oct 1973). (In German).

With a Monte Carlo program the dependence of the build-up factor on the shielding thickness for water, oil, and paraffin is calculated for 14.1 MeV neutrons. Elastic, inelastic scattering, absorption, and reflection of the neutrons for the different elements of the three materials are considered. Neutrons with an energy <0.1 MeV after a scattering process are eliminated. A strong dependence of the build-up factor on shielding thickness is found, with values at 40 cm shielding between 4 and 6 dependent on the material. The energy distribution of the neutrons and the number of collisions during penetration of the different materials are presented. (GE)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 19374 and 20518.

19917 (RT/FIMA-(73)1) FUNCTIONAL INTEGRATION FOR SOLVING THE SCHROEDINGER EQUATION. Bove, A.; Fano, G.; Teolis, A. G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 2 Aug 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

A Fortran program in order to compute the ground state wave function of the one-particle Schroedinger equation using the methods of Wiener's and Uhlenbeck–Ornstein's path integrals is worked out. An estimate of the error and a discussion of the choice of the parameters are also given. (auth)

19918 TRACE OF THE PRODUCT OF PAULI MATRICES OCCURRING AS $a_r = a_{r4}\sigma_1 + ia_{r4}$ AND THAT OF THE PRODUCT OF DIRAC MATRICES, AND THE INTERCONNECTION BETWEEN THEM. Sarkar, S. (Indian Association for the Cultivation of Science, Calcutta). Int. J. Theor. Phys.; 8: No. 3, 171-178(1973).

The $\sigma_i u \sigma_i$, $\sigma_i \sigma_j u \sigma_i \sigma_j$, $Tr(\sigma_i u)Tr(\sigma_i v)$, $Tr(\sigma_i \sigma_j u)Tr(\sigma_i \sigma_j v)$ and $Tr(u)$ where u and v involve Pauli matrices σ_i and the 2×2 unit matrix in the form of products of elements of the type $a_r = a_{r1}\sigma_i + ia_{r4}$ are evaluated with the help of the results of the trace calculation involving Dirac matrices. The $\gamma_\nu U \gamma_\nu$, $\gamma_\mu S \gamma_\mu$, $\gamma_\mu \gamma_\nu U \gamma_\mu \gamma_\nu$, $Tr(\gamma_\mu S)Tr(\gamma_\mu S')$, $Tr(\gamma_\mu \gamma_\nu U)Tr(\gamma_\mu \gamma_\nu V)$, $Tr(\gamma_5 U)Tr(\gamma_5 V)$, $Tr(\gamma_5 U)$ and $Tr(U)$ are evaluated. Here U, V are products of an even number of elements and S, S′ are products of an odd number of elements of the type $A = (A_\mu \gamma_\mu)$ The cases in which the dummy suffixes i and μ occurring in some of the above expressions are replaced by "a" which assume any specific value instead of implying a summation are dealt with. The evaluation of the above-mentioned traces when the term, $1 \pm \gamma_5$, occurs within the trace brackets is considered; this is required in the calculation of the traces involving σ_i and the unit 2×2 matrix. It was shown that the problem of the trace calculation involving Dirac matrices can be reduced to one involving three Pauli matrices σ_i and the unit 2×2 matrix. (auth)

19919 INTERPRETATION OF QUANTUM MECHANICS. Audi, M. Chicago; University of Chicago Press (1973). 210p. $11.50.

A two-fold philosophical thesis regarding quantum mechanics is presented. It is first argued that quantum mechanics is an essentially indeterministic theory and, by extension, that those physical processes described by the theory are indeterministic. Secondly, it is argued that if this indeterminism is genuinely accepted, all the philosophical problems of interpreting quantum theory become tractable. (LBS)

19920 CHOICE OF N-PARTICLE FUNCTIONS IN CONNECTION WITH THE RAYLEIGH–RITZ METHOD APPLIED TO THE THREE-PARTICLE SYSTEM H_2^+. Almstroem, H. (Royal Inst. of Tech., Stockholm). Lett. Nuovo Cim.; 8: No. 17, 983-987 (22 Dec 1973).

A scheme previously developed for a certain set of functions for calculating the eigenfunctions of N-particle systems is generalized in such a way as to permit the functions in the new set to depend on any number of nonlinear parameters. The choice of the N-particle functions is discussed, after which the calculation of the matrix elements is briefly treated. Some results obtained for the system H_2^+ are then presented. (LBS)

19921 ESTIMATES OF THE COUPLING CONSTANT OF YANG–LEE BARYON FIELD BASED ON THE EXISTENCE OF THE RELICT RADIATION. Berezin, V. A.; Markov, M. A. (Lebedev Inst. of Physics, Moscow). pp 17-24 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

19922 FIELD THEORY IN CURVED MOMENTUM SPACE WITH POSITIVELY DEFINITE METRIC. Vologodskii, V. B. (Lebedev Inst. of Physics, Moscow). pp 25-33 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

19923 RELATIVISTIC WAVE EQUATIONS FOR PARTICLES WITH SPIN AND THEORIES OF OBLIQUE MAGNETIC ROTATOR. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow). pp 192-199 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Within the framework of the classical theory the problem of the proper field reaction for the extended "particle" with non-zero dipole magnetic moment is discussed. Its relationship with some difficulties in highest spin particle theories and with a general theory of relativistic wave equations is pointed out. It is shown that the theory of an oblique magnetic rotator can be used in macroscopic physics (in particular, it can be applied to pulsars). (auth)

19924 QUANTUM FOUNDATIONS OF THE EXPONENTIAL DECAY LAW. Fonda, L.; Ghirardi, G. C.; Rimini, A.; Weber, T. (Univ., Trieste, Italy). Nuovo Cim.; 18A: No. 4, 805-807(21 Dec 1973).

It is shown that the upper bound of I(x) given by $|I(x)| < \exp[-\lambda x]$ constant is valid. (LBS)

19925 QUANTUM STATISTICAL MECHANICS OF NON-HAMILTONIAN SYSTEMS. Kossakowski, A. (Univ., Torun, Poland). Rep. Math. Phys.; 3: No. 4, 247-274(Dec 1972).

An axiomatic definition of time evolution (dynamical semi-group) of a physical system was given. A dynamical semi-group is defined as a one-parameter semi-group of linear endomorphisms of the set of all density operators corresponding to the physical system in question. Some classes of dynamical semi-groups (quantum Poisson and Brownian processes) induced by Markov processes on topological groups are described. Examples of dynamical semi-groups for the harmonic oscillator are given. (auth)

19926 EXAMPLE OF THE SINGLE-TIME MANY-PARTICLE RELATIVISTIC WAVE EQUATION. Sokolov, S. N. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 18: No. 1, 56-65(Jan 1974). (In Russian).

An example of relativistic wave equation for the system of N particles with a potential interaction including only the N-particle forces, is given. The equation is formulated in the variables t, $g_1, g_2, \ldots$, where g_i are 3-dimensional parts of the 4-velocities, and represents a direct generalization of the Schrödinger equation in the p-representation. The transformations of the wave function allowed by the equation form a group isomorphic to the Poincaré group, and after the switching-off the interaction, a group isomorphic to the direct product of the N Poincaré groups. An analog of the configuration X-space is constructed, and it is shown that the equation is in accordance with the classical relativistic mechanics of many-body systems. (auth)

19927 SEPARATION OF THE NORMAL AND THE SUPERFLUID MOTIONS IN THE SCHROEDINGER EQUATION BY MEANS OF THE DISPLACEMENT AND COLLECTIVE VARIABLES METHOD. Vakarchuk, I. A.; Yukhovskii, I. R. (Inst. of Theoretical Physics, Uzhgorod, USSR). Teor. Mat. Fiz.; 18: No. 1, 90-107(Jan 1974). (In Russian).

With the aid of the displacement method, the wave function of interacting bosons is represented as a product of the ground state function and the function describing the excitations in the system. The equations for these functions are solved in the collective variables representation by means of a special perturbation method free of divergences. The expressions obtained for the wave functions, the energy of the ground state, the energy spectrum and the damping of collective excitations are investigated. (auth)

19928 PROPERTIES OF EIGENFUNCTIONS OF THE SCHROEDINGER OPERATOR WITH PERIODIC POTENTIAL IN THE PRESENCE OF MAGNETIC FIELD. Dyakin, V. V. (Inst. of the Physics of Metals, Sverdlovsk, USSR). Teor. Mat. Fiz.; 18: No. 1, 70-77(Jan 1974). (In Russian).

By means of functional analysis methods properties of eigenfunctions of the Schrödinger operator with periodical potential combined with the constant magnetic field are investigated. The operator is considered on the functions defined on the whole-three-dimensional space. (auth)

19929 DESCRIPTION OF PHYSICAL SYSTEMS. Bugajska, K.; Bugajski, S. (Silesian Univ., Katowice, Poland). Rep. Math. Phys.; 4: No. 1, 1-20(Mar 1973).

A general "logical" scheme, containing both classical and quantum mechanics, is developed on the basis of plausible axioms. The division of states and yes-no measurements is introduced into sharp and diffuse ones, and it is proven that sharp states possess their carriers. Owing to this result, the existence of lattice joins and meets is proved for a wide class of elements of the logic. This "semi-lattice" structure gives the familiar lattice picture for special cases of classical and quantum mechanics. The notion of quantum super-position is introduced in this general scheme. It is proved that if in the theory appear nontrivial quantum superpositions, then this theory is "undeterministic" and vice versa. Further analysis of the pure state space leads to the construction of the canonical embedding of the general logic into an orthomodular complete ortho-lattice. After defining the prob-

ability of transition between pure states, the pure state space appears to be a generalization of Mielnik's "probability space" of quantum mechanics. (auth)

19930 ORTHOGONALITY POSTULATE IN AXIOMATIC QUANTUM MECHANICS. Maczynski, M. J. (Univ., Warsaw). Int. J. Theor. Phys.; 8: No. 5, 353-360(1973).

Let $p(A,\alpha,E)$ be the probability that a measurement of an observable A for the system in a state α will lead to a value in a Borel set E. An experimental function is a function f from the set of all states ρ into [0,1] for which there are an observable A and a Borel set E such that $f(\alpha) = p(A,\alpha,E)$ for all $\alpha \in \rho$. A sequence $f_1, f_2, \ldots$ of experimental functions is said to be orthogonal if there is an experimental function g such that $g + f_1 + f_2 + \ldots = 1$, and it is said to be pairwise orthogonal if $f_i + f_j \leq 1$ for $i \neq j$. It is shown that if one assumes both notions to be equivalent then the set L of all experimental functions is an orthocomplemented partially ordered set with respect to the natural order of real functions with the complementation $f' = 1 - f$, each observable A can be identified with an L-valued measure μ_A, each state α can be identified with a probability measure m_α on L and one has $p(A,\alpha,E) = m_\alpha \circ \mu A(E)$. Thus the abstract setting of axiomatic quantum mechanics as a consequence of a single postulate is obtained. (auth)

19931 FINITE LIMIT SETS FOR TRANSFORMATIONS ON THE UNIT INTERVAL. Metropolis, N.; Stein, M. L.; Stein, P. R. (Los Alamos Scientific Lab., NM). J. Comb. Theory; 15: No. 1, 25-43(Jul 1973). (LA-DC-12449).

An infinite sequence of finite or denumerable limit sets is found for a class of many-to-one transformations of the unit interval into itself. Examples of four different types are studied in some detail; tables of numerical results are included. The limit sets are characterized by certain patterns; an algorithm for their generation is described and established. The structure and order of occurrence of these patterns is universal for the class. (auth)

19932 HAMILTONIANS ALLOWING WAVE EQUATIONS. Arens, R. Int. J. Theor. Phys.; 8: No. 6, 391-408(1973).

A general criterion of when a Hamiltonian system has a wave equation is set up, and all such Hamiltonian systems (and hence all wave equations) are found. It is shown that the correspondence is one-to-one. (auth)

19933 DEGENERACIES OF QUANTUM SYSTEMS. Dowker, J. S. (Univ. of Manchester, Eng.). Int. J. Theor. Phys.; 8: No. 5, 319-320(1973).

The quantum mechanics of a system whose configuration space, M, possesses a transitive group of motions, G are considered. M is identified with the homogeneous space G/H where H is a subgroup of G. For simplicity it is assumed that G is compact and semi-simple. M can be endowed with a G-invariant Riemannian metric and it is assumed that Schrodinger's equation takes a covariant form. (UK)

19934 COMMENTS ON TRANSITION FROM CLASSICAL TO QUANTUM MECHANICS IN GENERALIZED COORDINATES VIA THE COVARIANT DERIVATIVE. Gruber, G. R. (Hofstra Coll., Hempstead, NY). Int. J. Theor. Phys.; 8: No. 6, 463-464 (1973).

It is shown why one cannot make a transition from classical to quantum theory in generalized coordinates via the covariant derivative. An interesting connection is shown between the covariant derivative operator and the "measurable" generalized momentum operator. (UK)

19935 REMARKS OF THE POISSON EQUATIONS OF MOTION. Jannussis, A. (Univ. of Patras, Greece); Papaloucas, L. Phys. Lett.; 46A: No. 3, 181-182(17 Dec 1973).

In respect of Poisson's equations of motion, solutions of the form $F_0(H) \exp\{iU(p, q)\}$, which have a physical significance and are of importance for the calculation of phase operators in quantum mechanics, are given. (auth)

Quantum Field Theories

Refer also to abstracts 19374, 19449, 19490, 19492, 19500, 19561, 19994, 19996, and 19997.

19936 (JINR-E2-7604) STRONG COUPLING DECOMPOSITION OF THE GROUND STATE FUNCTIONAL IN THE QUANTUM FIELD THEORY MODEL OF NEUTRAL SCALAR FIELD WITH THE SELF-ACTION GPHI^4 IN THE CASE OF TWO-DIMENSIONAL SPACE-TIME. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The argumentation is given that the solution of the equation (1) for the ground state functional in the case of strong coupling (5) can be represented as a Taylor series in the powers of parameter ϵ. This series has a non-zero convergence radius. (auth)

19937 (SLAC-Trans-162) BOUND STATES OF THE RELATIVISTIC THREE-BODY SYSTEM. Atansov, A. (Joint Inst. For Nuclear Research, Dubna (USSR)). 1970. Translation of JINR-P2-5336. 11p. Dep. NTIS $3.00.

A method is suggested to determine the upper limit of the number of bound states and their masses for a simple model in the quasipotential approach for the quantum field theoretical three-body problem. An equation is obtained which is similar to the nonrelativistic Schroedinger equation. By a proper transformation it is reduced to an equivalent equation with a Hermitian integrable kernel. (JFP)

19938 FOURTH INDETERMINANCY RELATION AND STOCHASTIC ELECTRODYNAMICS. Surdin, M. (Bordeaux Univ., Tallance, France). Int. J. Theor. Phys.; 8: No. 3, 183-187(1973).

An interesting conservation property and the time-energy uncertainty are derived in the framework of stochastic electrodynamics. (auth)

19939 UNIFIED THEORIES FOR MASSIVE SPIN 1 FIELDS. Shamaly, A.; Capri, A. Z. (Univ. of Alberta, Edmonton). Can. J. Phys.; 51: No. 14, 1467-1470(15 Jul 1973).

A pair of sets of first-order differential equations is given. They contain as special cases all the known spin 1 theories except the Stueckelberg formalism. It is also known that all of these theories are essentially causal. (auth)

19940 ANOMALIES VIA DIMENSIONAL REGULARIZATION. Akyeampong, D. A.; Delbourgo, R. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 19A: No. 2, 219-224(21 Jan 1974).

Anomalous Ward identities arise when the Lagrangian in 21-dimensional space-time is not invariant under the symmetry transformation in question with 1 arbitrary. (The anomalous symmetry-breaking terms have associated a factor 21−4 and disappear at the classical level in four dimensions.) In particular, the axial anomaly is connected with the chiral breaking due to the fermion kinetic energy and the canonical trace anomaly is a consequence of dilatation noninvariance of any interaction. (auth)

19941 COMMENTS ON THE HIGGS PHENOMENON. Ferrari, R. (Univ., Pisa, Italy). Nuovo Cim.; 19A: No. 2, 204-218(21 Jan 1974).

The Higgs model is briefly reviewed and in this model the Goldstone theorem is discussed and the mechanism by which the gauge vector field becomes massive. The properties of the four-momentum and of the metric are studied. In particular it is found that the translations are not unitarily implemented. A solvable model in four space-time dimensions is given that has a solution with the following properties: the theory is gauge invariant and this symmetry is spontaneously broken, however there is no massive vector field in the solution. (auth)

19942 GAUGE DEPENDENCE OF ULTRAVIOLET BEHAVIOR OF GAUGE THEORIES. Hosoya, A.; Sato, A. (Osaka Univ., Toyonaka, Japan). Phys. Lett.; 48B: No. 1, 36-38(7 Jan 1974).

The gauge dependence of ultraviolet behavior of gauge theories is examined on the basis of renormalization-group equation. Non-Abelian gauge theories are confirmed to be asymptotically free in an arbitrary gauge. It is also shown that the effective gauge parameter approaches a finite value in the ultraviolet limit in contrast with the case of QED. (auth)

19943 CLIFFORD-ALGEBRA FORMULATION OF MULTISPIN FIELD EQUATIONS. Doria, F. A. (Univ., Rio de Janeiro). Lett. Nuovo Cim.; 8: No. 17, 994-996(22 Dec 1973).

The Clifford algebra formulations of multispin field equation are given for integer and half-integer spin. It is shown how they may be obtained from the usual multispin field equations—for integer spin the Fierz's system is obtained, and for half-integer spin the Rarita–Schwinger's system is obtained. (LBS)

19944 COMMENTS ON NEW TAMM–DANCOFF METHOD. Heisenberg, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 34-36 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In German).

19945 QUANTUM FIELD THEORY AND MOMENTUM SPACE OF CONSTANT CURVATURE. Kadyshevskii, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 52-73 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

It is shown that quantum field theory formalism which satisfies relativistic and translational invariance can be developed in a

curved relative momentum space. In this new formalism the dynamical equations, the structure of the matrix elements, etc. are modified essentially in the region of large energies and momenta which are comparable with the inverse radius of curvature. (auth)

19946 DIFFERENTIAL WITH RESPECT TO COUPLING CONSTANT FORMULATION OF QUANTUM THEORY. Kirzhnits, D. A. (Lebedev Inst. of Physics, Moscow). pp 74-95 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

A new method of description of quantum systems is developed, which is based on the law of evolution of the system with the variation of the coupling constant. Some applications of this method to the problem of two-particle scattering in nonrelativistic theory and also in quantum field theory are given. (auth)

19947 TWO BODY PROBLEM IN QUANTUM FIELD THEORY. Logunov, A. A.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). pp 96-106 of Problems of Theoretical Physics. Ginzburg, V. L. (ed). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

It is shown that a system of two interacting particles can be consistently described within the framework of equal-time formalism. A relationship between the wave function of the system and the free wave function is established. It leads to the possibility to describe two body systems in quantum field theory by three-dimensional equations and to conserve the probability interpretation of the wave function. (auth)

19948 QUANTUM FIELD THEORIES WITH NON-POLYNOMIAL INCREASE OF MATRIX ELEMENTS. Fainberg, V. Ya. (Lebedev Inst. of Physics, Moscow). pp 119-145 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The review of some new methods and results (of application) of axiomatic approach to quantum field theories with non-polynomial increase of matrix elements (i.e. to so called localizable and non-localizable field theories) is presented. Properties of Wightman functions and their consequences for such theories are considered (in particular, limitations imposed on the increase of elastic scattering amplitude at high energies). A relationship between Lagrange and axiomatic approaches to localizable and non-localizable field theories is briefly discussed. (auth)

19949 S-MATRIX FOR GENERAL NONLINEAR LAGRANGIANS. Fradkin, E. S. (Lebedev Inst. of Physics, Moscow). pp 146-176 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Within the framework of the functional integration method theories with general non-linear Lagrangian (polynomial as well as non-polynomial interaction, gauge-invariant interaction, dual model etc.) are considered. The formal unitarity of S-matrix for such interactions is shown. The problems of a convergence are treated. For a model of a renormalizable theory the problem of an approximate scale invariance is considered. (auth)

19950 ROLE OF THE CONNECTION BETWEEN SPIN AND STATISTICS IN QUANTUM ELECTRODYNAMICS WITH PAIR CREATING EXTERNAL FIELD. Nikishov, A. I. (Lebedev Inst. of Physics, Moscow). pp 299-305 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

If one supposes that field does not create pairs at $t \to \pm\infty$ and does not take into account the radiative effects, then the total probability of scattering can be shown to be equal to one. In order to draw this conclusion, the connection between spin and statistics is important. (auth)

19951 RADIATIVE CORRECTIONS TO THE MOTION OF ELECTRONS AND PHOTONS IN AN INTENSE FIELD AND THEIR ANALYTIC PROPERTIES. Ritus, V. I. (Lebedev Inst. of Physics, Moscow). pp 306-334 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Diagonalization and general properties of the mass and polarization operators and Green functions of an electron and a photon in an intense crossed field are considered exactly in the external and radiation fields. Their explicit expressions are obtained in the e^2-approximation in the radiation field, and exactly in the external field and on the mass shell determine the elastic scattering amplitudes and other physical quantities, for example the dependence of the anomalous magnetic moment of the electron on the field and particle momentum. Due to instability of the electron and photon in the field the analytic properties of the mass and polarization operators differ from those in vacuum: they become entire transcendental functions of the momentum square and nontrivially depend on the dynamic variable which is proportional to the particle momentum and to the field, in which these operators have an essential singularity and branching at zero. The Green functions in the complex momentum square plane besides the one-particle pole have an infinite number of poles instead of the branching and cut which corresponded to the spectrum of two-particle states. All the poles depend on the dynamic variable and have the imaginary parts of the appropriate sign which provide correct causal properties. Different branches in the dynamic variable form a retarded and advanced functions. (auth)

19952 NONZERO MASS CORRECTION TO THE SUPERPROPAGATOR. Georgalas, C. G. (Nuclear Research Center Democritus, Athens). Particles Nucl.; 6: No. 2-3,49-54(1973).

The zero mass substitution, ($\Delta = \frac{1}{4}\pi^2 r^2$) often used in non-polynomial Lagrangian field theory in order to obtain closed expressions for the superpropagator, is treated in this paper as the zero-order term of an appropriately defined series. It is shown that much of the information lost in the zero mass limit can be recovered by keeping also the first order term. For positive s, a simple expression is derived giving the Fourier transform D(p,z) of Δ^s in terms of this first order correction. (auth)

19953 RELATIONSHIP BETWEEN CAUSALITY, IN A CLASSICAL RELATIVISTIC FIELD THEORY, AND LORENTZ INVARIANCE, IN THE CORRESPONDING QUANTUM THEORY, FOR A MASSIVE SPIN-ONE FIELD IN EXTERNAL POTENTIALS. Jenkins, J. D. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 12, 1935-1942(Dec 1973).

For reasons of calculational simplicity, a massive spin-one field, interacting with external potentials, is described in terms of the Stückelberg formalism (Helv. Phys. Acta.; 11: 299-328 (1938)). Some points, concerning necessary and sufficient conditions for the classical theory to be causal, in the sense of Velo and Zwanziger (Phys. Rev.; 186: 1337-41 (1969) and Phys. Rev.; 188: 2218-22 (1969)), are clarified. It is then shown that with a simple restriction on the type of interaction considered, the classical theory is causal, in the above sense, if and only if the corresponding quantum theory is Lorentz invariant, in that the S operator in the interaction picture is normal independent. Incidental in this demonstration is the result that the characteristic and Lee–Yang determinants share the same form. It is indicated how this result generalizes to interactions between Stückelberg, Klein–Gordon and electromagnetic fields; and the validity of the result, in the more usual vector formalism, is established. (auth)

19954 NOTE ON MASSLESS FIELD EQUATIONS FOR ARBITRARY SPIN. Dowker, J. S. (Univ. of Manchester, Eng.). Int. J. Theor. Phys.; 8: No. 5, 321-322(1973).

It is stated that Lord in a recently published article (Int. J. Theor. Phys.; 5: No. 5, 349 (1972)) proves the equivalence of the massless field equations written down by Nelson & Good (Phys. Rev.; 179: 1445 (1969)) to those of Dirac. It is pointed out however that the entire analytical development, as well as the aforementioned equations, can be found in earlier work. (UK)

19955 QUANTIZATION OF A MINIMALLY COUPLED SPIN-3/2 FIELD. Nagpal, A. K. (Univ. of Delhi). Lett. Nuovo Cim.; 9: No. 4, 137-140(26 Jan 1974).

It is argued that the Yang–Feldman technique is not, a priori, appropriate for the quantization of a spin-$^3/_2$ field. It is shown that the inconsistencies seen on using the canonical method of quantization are reflected also in the results obtained by means of tne Yang–Feldman technique. (LBS)

19956 OVERSUBSTRACTIONS AND DIMENSIONAL REGULARIZATION. Bandelloni, G. (Univ., Genoa). Lett. Nuovo Cim.; 9: No. 3, 79-82(19 Jan 1974).

The problem of oversubtractions in the renormalization scheme is discussed. The generalized Feynman vertex amplitude with L internal boson lines in a v-dimensional space is considered. The Feynman diagram is calculated, in which all the vertices have their canonical dimensions; oversubtractions are then introduced. The new divergences in the amplitude to be regularized are redefined, but still maintaining the tree and two-tree structure of the graph. (LBS)

19957 PROPAGATION OF MASSLESS FIELDS. Kranold, H. U. (Univ., Marburg, Ger.). Int. J. Theor. Phys.; 8: No. 5, 385-389(1973).

An inequality is discussed expressing the idea that a physical quantity associated with massless fields should "propagate at the speed of light". It is shown that the inequality holds for the energy of massless bosons of spin zero and one. auth)

19958 REMARKS ON NONRENORMALIZABLE INTERACTIONS. Klauder, J. R. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Lett.; 47B: No. 6, 523-525(24 Dec 1973).

It is argued that certain quantum field theories, including conventional nonrenormalizable theories, do not reduce to free theories when the interaction is turned off. The limiting, "pseudo-free" theories are formally characterized and suggested as alternative "unperturbed" theories possibly suitable for a meaningful perturbation analysis. (auth)

19959 DIRECTION DEPENDENCE OF COMPOSITE FIELD OPERATORS AND DILATATION-INVARIANT WIGHTMAN FUNCTIONS. Otterson, P. (Pontificia Universidade Catolica, Rio de Janeiro). Nuovo Cim.; 18A: No. 4, 683-696(21 Dec 1973).

The coefficient functions occurring in the matrix elements of the Wilson–Zimmerman expansion are canonically related to dilatation-invariant functions satisfying several of the linear Wightman axioms. Simple holomorphy properties are derived. (auth)

19960 REGULARIZATION OF THE LEE MODEL THROUGH ANALYTIC CONTINUATION OF OPERATORS. Marinaro, M.; Mercaldo, L.; Scarpetta, G. (Univ., Naples). Nuovo Cim.; 18A: No. 4, 615-634(21 Dec 1973).

A procedure was developed to obtain from the formal Hamiltonian of the Lee model with Y-interaction the renormalized Hamiltonian. The method is based on the analytic continuation of field operators. (auth)

19961 GOLDSTONE FIELDS WITH A SPIN ONE HALF. Akulov, V. P.; Volkov, D. V. (Physical–Technical Inst., Kazan). Teor. Mat. Fiz.; 18: No. 1, 39-50(Jan 1974). (In Russian).

Phenomenological action integral for the fermion Goldstone fields is considered, which is invariant under the transformations from the Poincare' group as well as under the transformations in the spinor space. (auth)

19962 R-OPERATION IN THE $\lambda\phi^4$-THEORY AS A CONSEQUENCE OF INDEFINITE METRICS IN THE EXTENDED SPACE OF STATES (LOWEST ORDERS). Zav'yalov, O. I.; Medvedev, P. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 18: No. 1, 27-38(Jan 1974). (In Russian).

It is shown that the iterative solution of the Heisenberg equations of motion for the creation-annihilation operators in the quasi-Fock space in two lowest orders of the perturbation theory gives automatically the field, which is renormalized by means of a certain R-operation. Thus the expressions for the mass renormalization constant as well as for the wave function renormalization constant Z_3 turn out to be finite in the quasi-Fock space. (auth)

19963 AXIOMATIC METHOD IN QUANTUM ELECTRODYNAMICS. Solov'ev, L. D. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 18: No. 1, 3-13(Jan 1974). (In Russian).

A method in the theory of electromagnetic interactions is suggested, which is free from the infrared divergences. The method is based on the equations of the Bogolubov axiomatic approach in quantim field theory, from which the infrared divergences are removed. Exact consequences of the equations are discussed, such as the low energy theorems and dispersion relations in all orders with respect to the electromagnetic interaction. All the model-independent terms in the infrared asymptotics of the Green function of charged spinless particle are given out. (auth)

19964 TAKING INTO ACCOUNT THE FIELD REACTION IN QUANTUM THEORY. Grigor'ev, V. I. (Moscow State Univ.). Teor. Mat. Fiz.; 18: No. 1, 66-69(Jan 1974). (In Russian).

The operator is found which takes into account the reaction of quantized field to the particle generating this field. This result generalizes the previously made investigations on quantum theory with the account of the damping effects. (auth)

19965 FINITE AND INFINITESIMAL CANONICAL TRANSFORMATIONS IN CLASSICAL FIELD THEORY. Testa, F. J. (Atmospheric Environment Service, Downsview, Ont.). Physica; 69: No. 2, 579-586(1 Nov 1973).

By employing functional calculus, the general relation between the finite and infinitesimal generating functionals of a 1-parameter subgroup of canonical transformations in classical field theory is obtained. This relation is found to be simply a generalization of the Hamilton–Jacobi functional differential equation. When the latter relation is solved for the finite generating functional, the connections for a finite transformation can be determined without the need for integration of the associated infinitesimal transformation. (auth)

19966 NON-HAMILTONIAN APPROACH TO CONFORMAL QUANTUM FIELD THEORY. Polyakov, A. M. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 1, 23-42 (Jan 1974). (In Russian).

A requirement of completeness of the operator set involved in the theory at small distances is formulated which replaces the unitarity condition of the S-matrix in the usual theory. Explicit expressions are obtained for the contribution of the intermediate state with a definite symmetry in the Wightman function. Together with the "localization" condition the completeness condition leads to a set of algebraic equations for the anomalous dimensionalities and interaction constants which may be regarded as the sum rule for these quantities. The approximate solutions of the equations found in $4-\epsilon$ dimension space yield results which are equivalent to the Hamiltonian approach. (auth)

19967 DEFINITION OF THE PRODUCT $\delta(x).x^{-\alpha}(\alpha > 0$, real) AND ITS APPLICATIONS. Lukierski, J.; Sznajder, S. (Univ., Wroclaw). Rep. Math. Phys.; 4: No. 1, 65-75(Mar 1973).

New space of continuous test functions $\tilde{S}$ having at $x = 0$ an asymptotic expansion in Dirichlet series is introduced. It is shown that on the space $\tilde{S}$ the product $\delta(x).x^{-\alpha}(\alpha > 0$, real) is a local linear continuous functional, proportional to the derivative of continuous order $\delta^{(\alpha)}$ of Dirac delta. It is shown that the product $\delta(x).x^{-\alpha}$ occurs in quantum field theory asymptotically invariant with respect to the dilatation group, if causal or retarded propagators are differentiated. (auth)

19968 GEOMETRIZATION OF THE CANONICAL FORMALISM IN THE CLASSICAL FIELD THEORY. Gawedzki, K. (Univ., Warsaw). Rep. Math. Phys.; 3: No. 4, 307-326(Dec 1972).

The Poisson bracket definition in the multisymplectic formulation of an arbitrary nonlinear classical field theory is dealt with. The Poisson brackets of physical quantities related to a given space-like 3-dimensional surface are defined. (auth)

19969 VERTEX BOOTSTRAP FOR THE FINE-STRUCTURE CONSTANT. Englert, F. (CEN, Saclay, France); Frere, J. M.; Nicoletopoulos, P. Nuovo Cim.; 19A: No. 3, 395-429(1 Feb 1974).

The possibility of converting the Baker-Johnson-Adler eigenvalue equation $F(\alpha) = 0$ for the fine-structure constant into a simpler condition is discussed in the framework of the self-consistent (bootstrap) formulation of massless quantum electrodynamics. It is shown that the imposition of a strong convergence condition on the vertex bootstrap equation in the canonical (generalized Landau) gauge leads to an eigenvalue equation for α, $\tilde{Z}_{1c}(\alpha) = 0$, which is consistent with the gauge covariance of the theory and implies $F(\alpha) = 0$. The function $\tilde{Z}_{1c}(\alpha)$ may be expanded in a power series in α through Feynman graphs. (auth)

19970 COVARIANCE PROPERTIES OF FIELDS UNDER INVERSION AND FINITE CONFORMAL TRANSFORMATIONS. Ciccariello, S. (Univ., Padua); Sartori, G. Nuovo Cim.; 19A: No. 3, 470-500(1 Feb 1974).

The covariance properties of fields are studied which according to Mack and Salam's terminology transform as conformal tensors of class Ib and II. A theorem is proved which states the conditions in order that a vector basis of class Ib fields can be turned into a basis of class Ia by subtracting derivatives of the same basic fields. A consequence of this result is a simple rule which allows all the possible conformal covariant free-field equations to be written. Finally, the conditions for the existence of a unitary inversion operator, as well as the transformation properties of fields under it, have been explicitly determined. (auth)

19971 PRINTSIP OTNOSITEL'NOSTI. Sbornik Rabot po Spetsial'noi Teorii Otnositel'posti. (Principles of Relativity. Collection of Works on the Special Theory of Relativity). Tyapkin, A. A. (comp.). Moscow; Atomizdat (1973). 332p.

The basic publications of classic relativism in which the relativity theory of Lorentz, Poincare, and Einstein was first formulated are compiled together with the publications of other pioneers in the field. The origin of the concept of relativity is considered, the construction of the special theory of relativity is examined and the history of the construction of the special theory of relativity is given. (JSR)

Gravitation and General Relativity

Refer also to abstracts 19464, 19491, and 19557.

19972 PRESSURE-VOLUME RELATION OF ISOTHERMAL GAS SPHERES WITHIN THE FRAMEWORK OF GENERAL RELATIVITY. Yabushita, S. (Kyoto Univ.). Mon. Notic. Roy. Astron. Soc.; 165: No. 1, 11-15(1973).

The equation of state $p = q\rho$ is adopted, where p and ρ denote pressure and energy-density, respectively, and q is a constant, and the conditions of hydrostatic equilibria within the framework of general relativity are used to obtain the relation between the

radius of a gas sphere and the pressure which it exerts at the boundary. It is shown that for given total energy, the pressure-volume relation is similar to the corresponding relation for isothermal gas spheres calculated in the Newtonian theory. In particular there exists a maximum pressure which the gas sphere can withstand. Hence, if the relativistic gas sphere is surrounded by an envelope, and if the envelope exerts at the boundary a pressure greater than the maximum pressure, the gas sphere cannot be in static equilibrium. (auth)

19973 HOMOGENEOUS GRAVITATIONAL FORCE FIELD IN GENERAL RELATIVITY. Goodinson, P. A. (Queen Elizabeth Coll., London). Int. J. Theor. Phys.; 8: No. 3, 179-182(1973).

The concept of a gravitational force in general relativity is reintroduced. The theory of space-like congruences is established and is applied to the discussion of the existence of a homogeneous gravitational force-field in curved space-time. It is shown in vacuum (vanishing Ricci tensor) that such a force-field cannot exist. (auth)

19974 PERCEPTION AND OPERATION IN THE DEFINITION OF OBSERVABLE. Cole, E. A. B. (Univ. of Leeds, Eng.). Int. J. Theor. Phys.; 8: No. 3, 155-170(1973).

A discussion of the roles of assumption and abstraction in physics is presented, with emphasis on the fact that if abstractions are used long enough it becomes difficult to disentangle them from what is actually observed. The unclear meaning of the word same in the context of two observers measuring the same observable is also discussed. An observable is defined operationally as a list of instructions, and this definition also defines the word same in this context. Methods for the combination of these observables are presented. An observer decides whether or not a list of instructions is physically realizable by examining the states of the system, and it is shown how these states are based on the observer's powers of perception. Finally, an account of the operational nature of cellular space-time is given, the fuzzy nature of the cell boundaries is discussed, and it is shown how measuring rods consisting of "straight" strings of cells may be constructed. (auth)

19975 CONTINUOUS ISOTROPIC HYPERSURFACES IN A SPACE-TIME. Cochina, A. Rev. Roum. Math. Pures Appl.; 17: No. 10, 1591-1597(1972). (In French).

The following result is obtained: the V_3^2 (1) continuous isotrope hypersurfaces in a V_4^1 Takeno space-time are double isotropic. A $V_{3_1}^1$ (1) $\subset V_4^1$ hypersurface has a form of ω distinct connection which is a form of pseudocontact and which admits a ∞^1 of characteristic fields on the V_3^2 (1). The scalar torsion of a $V_{3_n}^1$ (1) $\subset V_4^1$ hypersurface and the strict components of the volume form corresponding to ω are simply expressed in accordance with the connection coefficient which is something apart of the isotrope hypersurface. (auth) (Rom. Sci. Abstr.)

19976 KERR-SCHILD METRIC AND SUPERPOSITION OF FIELDS IN GENERAL RELATIVITY. Misra, M. (Gujarat Univ., Ahmedabad, India). Lett. Nuovo Cim.; 8: No. 18, 1011-1012(29 Dec 1973).

It is shown that the Einstein tensors for the three metrics $g_{ij} = \eta_{ij} + 2G\varphi_i\psi_j$, $\bar{g}_{ij} = \eta_{ij} + 2H\psi_i\psi_j$, and $g'_{ij} = \eta_{ij} + 2h\psi_i\psi_j$ are linearly, though inhomogeneously, related. It is implied that the energy tensors corresponding to the three metrics will also be related, and that it should be possible to generate new solutions of the field equations from pairs of solutions subject to the conditions on φ_i which include shear-free character. (LBS)

19977 INCONSISTENCY OF A CLASS OF GRAVITATIONAL THEORIES. Spinelli, G. (Istituto di Matematica del Politecnico, Milan). Lett. Nuovo Cim.; 8: No. 18, 1031-1035(29 Dec 1973).

The nonlinear tensor gravitational theories in the renormalized flat space time are considered, using a field theoretical approach. It is shown that, in the interaction Lagrangian density, coupling the gravitational potential to the total energy momentum tensor leads to inconsistencies. (LBS)

19978 ELECTROMAGNETIC-RADIATION DAMPING IN A LINEARIZED KERR BACKGROUND. Beig, R. (Institut fuer Weltraumforschung, Vienna). Lett. Nuovo Cim.; 8: No. 18, 1007-1010(29 Dec 1973).

The radiation reaction force acting on a charged point particle moving slowly in a linearized Kerr background is calculated, based on a fundamental paper on electromagnetic radiation in curved space-time by Brehme and DeWitt (Ann. of Phys., 9, 220(1960)). (LBS)

19979 GRAVITATIONAL WARD IDENTITIES. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste, Italy). pp 115-118 of Problems of Theoretical Physics. Ginzburg, V. L. (ed.). Moscow; Izdatel'stvo Nauka (1972).

In contrast with gauge theories of the internal kind such as electrodynamics or Yang-Mills theory, the connection between the two kinds of current—the conserved ones which are intimately connected with the source current of the gauge quanta and the source currents—is more subtle in the case of gravitons. The graviton source never coincides with the conserved current—in this case the energy-momentum tensor. (auth)

19980 TRANSFORMATION BETWEEN ORBITAL PARAMETERS IN DIFFERENT COORDINATE SYSTEMS OF THE GENERAL RELATIVISTIC SCHWARZSCHILD PROBLEM. Georgevic, R. M.; Anderson, J. D. (California Inst. of Tech., Pasadena). J. Franklin Inst.; 296: 275-286(Oct 1973).

The relation between the oscillating orbital elements for a family of solutions of the general relativistic Schwarzschild problems is developed. These relations provide a method for evaluating orbital elements in different Schwarzschild coordinate systems without the necessity of fitting to real data every time the system of coordinates is changed. The objectivity of different coordinate systems is discussed. Considerations of orbital motions favor the standard Schwarzschild metric, but the propagation of light signals is more objective in the metric of Painlevé. Because the orbital motions usually dominate the representation of data, the standard Schwarzschild coordinates are the best objective choice for most applications. (IAA)

19981 EINSTEIN'S INTERIOR FIELD EQUATIONS IN ELASTIC MEDIA. Roy, S. R.; Singh, P. N. (Banaras Hindu Univ., India). J. Phys., A (London); 6: No. 12, 1862-1866(Dec 1973).

A general solution of the field equations of general relativity theory was obtained for an elastic sphere of constant density. The equations were solved under the condition that the pressure is zero at the boundary of the sphere and the density is constant inside this boundary. The present investigation represents an attempt to apply Rayner's theory of elasticity (Proc. R. Soc.; A272: 44-53 (1963)) in general relativity for the construction of realistic models. (auth)

19982 BIRKHOFF'S THEOREM IN SCALAR-TENSOR THEORY OF GRAVITATION. Reddy, D. R. K. (Indian Inst. of Tech., Delhi). J. Phys., A (London); 6: No. 12, 1867-1870 (Dec 1973).

It is shown that an analog of Birkhoff's theorem of general relativity exists in a scalar-tensor theory of gravitation proposed by Sen and Dunn (J. Maths. Phys.; 12: 578-86 (1971)). Unlike in the Brans-Dicke scalar-tensor theory (Phys. Rev.; 124: 925-35 (1961)), Birkhoff's theorem is valid in the present theory irrespective of the nature of the scalar field introduced. (auth)

19983 TYPE N SOLUTIONS OF THE VACUUM SCALAR-TENSOR FIELD EQUATIONS. Lun, A. W. C.; McIntosh, C. B. G. (Monash Univ., Clayton, Australia). Gen. Relativity Gravitation; 4: No. 6, 475-487(Dec 1973).

All solutions of the vacuum relativistic scalar-tensor field equations $R_{\mu\nu} = -\phi_{,\mu}\phi_{,\nu}$ are given in the case where the Weyl tensor is of Petrov-Penrose type N. These eight solutions are listed according to the Petrov-Plebanski classification of their trace-free Ricci tensor components and belong to the three classes $[T-3S]_{[1\text{-}1]}(R,N)$, $[3T-S]_{[1\text{-}1]}(R,N)$, and $[4N]_{[2]}(0,N)$. (auth)

19984 BIMETRIC THEORY OF GRAVITATION. Rosen, N. (Technion-Israel Inst. of Tech., Haifa). Gen. Relativity Gravitation; 4: No. 6, 435-447(Dec 1973).

A bimetric theory of gravitation is proposed, satisfying the covariance and equivalence principles. It is based on a simple form of Lagrangian and has a simpler mathematical structure than that of the general theory of relativity. The theory agrees with general relativity up to the accuracy of the observations made up to now. The static spherically symmetric solution of the present field equations does not involve any "black hole". (auth)

19985 FERMI TRANSPORT AND THE CORIOLIS ACCELERATION. Enosh, M.; Kovetz, A. (Tel Aviv Univ., Israel). Gen. Relativity Gravitation; 4: No. 6, 417-420(Dec 1973).

The Fermi transport law is commonly used to construct "nonrotating" reference frames. The basis for this interpretation is the bouncing photon experiment and the vanishing of the Coriolis acceleration. The latter property is used to construct a transport law for spatial axes along an observer's world line in theories of gravitation more general than Weyl's (and Einstein's). Insistence on a transport law built on the first property precludes any generalization beyond Weyl's. (auth)

19986 LOCAL LINEAR INDEPENDENCE CONDITIONS AND QUATERNIONIC EQUATIONS OF GRAVITATION. Do Amaral, C. M.; Rodrigues, L. M. C. S. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). An. Acad. Brasil. Cienc.; 45: No. 1, 83-86(31 Mar 1973).

From Bergmann spinor formulation of general relativity and using local conditions of linear independence of the quaternionic gravitational potentials, a pair of quaternionic equations of gravitation are obtained. These equations are equivalent to those obtained by Sachs by variational methods. (auth)

19987 DISTORTING METRIC WITH VANISHING TWIST AND DIVERGENCE. Yadav, B. P. (Physical Research Lab., Ahmedabad, India). Phys. Lett.; 46A: No. 4, 253-254(31 Dec 1973).

In linear relativity, one obtains a gravitational field having irrotational and shearing geodesic rays with vanishing expansion for asymptotically flat vacuum space-time. Such a field is not allowed by field equations in nonlinear theory. (auth)

19988 YUKAWA BEHAVIOR OF STRONG GRAVITY. Friedl, J.; Inomata, A. (State Univ. of New York, Albany). Lett. Nuovo Cim.; 9: No. 3, 83-87(19 Jan 1974).

The asymptotic Yukawa behavior of strong gravity is discussed on the classical basis of the scalar-tensor theory in the version of Callen et. al. (Ann. of Phys., 59: 42(1970)). (LBS)

19989 BEHAVIOUR OF TEST MATTER IN THE VICINITY OF SINGULARITIES. Borzeszkowski, H. H. V. (Zentralinstitut fuer Astrophysik, Berlin). Int. J. Theor. Phys.; 8: No. 5, 331-335(1973).

The eikonal approximation of the Klein–Gordon equation in a Riemannian space is considered; this leads to the equations of timelike geodesics. It is shown that, in the vicinity of focal points, the eikonal limit is not valid for test matter focused by gravity. Therefore, first, in the vicinity of singularities considered in the so-called singularity theorems such test matter must be described by their (quantum) field equations and, second, there is no direct physical interpretation of incomplete timelike geodesics. (auth)

19990 METRIC ALLOWING A 2-PARAMETER GROUP OF MOTION. Pechlaner, E. (Simon Fraser Univ., Burnaby, B. C.). Int. J. Theor. Phys.; 8: No. 5, 337-339(1973).

Using heuristic arguments, a metric form is found, which might describe the field of "particles" having light velocity. It turns out that this metric, which allows a 2-parameter group of motion, indeed includes radiative solutions of the Einstein vacuum equations and of the Einstein–Maxwell equations. (auth)

19991 FINITE-AMPLITUDE DISTURBANCES IN SELF-GRAVITATING MEDIA. II. Tassoul, J. L.; Aubin, G. (Univ. of Montreal). J. Math. Anal. Appl.; 45: No. 1, 116-126(Jan 1974).

Finite-amplitude axisymmetric disturbances in a self-gravitating fluid column of finite radius R. It is shown that the cutoff wavelength λ_{nl} above which gravitational breakup occurs now depends on the relative amplitude ϵ/R of the initial perturbation. Actually, for small- but finite-amplitude disturbances, $\lambda_{nl} = \lambda_l (1 - 0.34368\ \epsilon^2/R^2)$, where λ_l (=5.8898R) designates the cutoff wavelength predicted in the linear approximation. (auth)

19992 LASER AMPLIFICATION BY GRAVITATIONAL FIELD. Biswas, P. K. (Univ. of Calcutta). Nuovo Cim.; 18B: No. 2, 345-353(11 Dec 1973).

The source equation is examined for the electric vector of radiation inside a maser cavity (W. E. Lamb jr.) and investigate if a volume density of polarization $P = (-2\Phi/c^2)\ E$, induced by gravitation (potential Φ) in space with an electric vector E, can stimulate maser oscillations (vacuum of course is the acting medium). The case of single-mode excitation is considered. It is seen that, if Φ does not vary with time, one gets frequency shift only. Wave amplification would necessarily require a time-dependent Φ. Assuming a periodicity $T_n = 2\pi/\nu_n$ in Φ, where ν_n is the angular frequency of the excited mode of radiation in the cavity resonator, it is seen that the $2\nu_n$ Fourier component in Φ is responsible for maser amplification. For the shift of frequency it is observed that it is of the same order as the gravitational red-shift. Examples are constructed with some optical resonators. (auth)

19993 CYLINDRICALLY SYMMETRIC ELECTROSTATIC FIELD IN EINSTEIN'S UNIFIED FIELD THEORY. Kashyap, J. N. S.; Upadhyay, V. D. (Banaras Hindu Univ., Varanasi, India). Indian J. Pure Appl. Math.; 4: No. 3, 253-258(Mar 1973).

A static composite field, which exhibits cylindrical symmetry and electric property, is considered. The solution of the field equations (Einstein 1953) shows that a unified field of this type is necessarily reducible to a composite field exhibiting plane symmetry. (auth)

19994 FIVE-DIMENSIONAL RELATIVITY THEORY. Leibowitz, E.; Rosen, N. (Technion–Israel Inst. of Tech., Haifa). Gen. Relativity Gravitation; 4: No. 6, 449-474(Dec 1973).

The five-dimensional relativity theory proposed by Kaluza (1921) is formulated covariantly for a Riemannian space containing a killing geodesic vector field. From this five-dimensional space a four-dimensional physical space is extracted. The field equations in empty 5-space are essentially uniquely determined and correspond to the Einstein–Maxwell equations in 4-space. In the presence of a field in 5-space the field equations involve a tensor which is associated with energy, momentum, charge and current densities in 4-space. For a 5-space containing dust the field equations lead to particle motion described by the geodesic equations. The latter correspond in 4-space to the Lorentz equations of motion for particles with arbitrary ratios of charge to mass and also for certain entities (tachyons and luminons) unobserved hitherto. (auth)

19995 EMBEDDING APPROACH TO A RESTRICTED COVARIANCE GROUP IN GENERAL RELATIVITY. Krause, J. (Univ. of Chile, Santiago). Nuovo Cim.; 18B: No. 2, 302-310 (11 Dec 1973).

Two features of the local embedding problem of relativistic manifolds are discussed. It is first shown how preferred coordinates can be found, and a set of "potentials" introduced, such that the curved metric becomes unambiguously decomposed in a flat metric plus a genuine gravitational part. This decomposition of the metric holds locally, at least, over that extended space-time region corresponding to the coordinate patch of the local embedding. Next, the transformation group which preserves the form invariance of this decomposition of the metric is presented. It corresponds to a wellknown enlarged Poincaré group, with the characteristic property, however, that the "potentials" are transformed conjointly with the preferred coordinates. (auth)

19996 NULL CO-ORDINATE DYNAMICS OF LINEARIZED GRAVITATION. Aragone, C. (Univ. Simon Bolivar, Caracas); Gambini, R. Nuovo Cim.; 18B: No. 2, 311-332(11 Dec 1973).

The null dynamics of the first-order linearized theory has different qualitative properties with respect to the wellknown dynamical analysis made by Arnowitt and Deser when it is chosen a preferred x^0 = const hypersurface. If one focuses the study on the hypersurfaces x^+ = const, the whole set of new constraints is found, and after having been introduced into the action it is seen that the dynamics depend upon 2 dynamical independent variables. These 2 independent variables, which correspond to the fact that the linearized gravitational field is a massless helicity-2 field, are self-conjugate in a Hamiltonian sense, i.e., these variables essentially coincide with their momenta. Thus the Hamiltonian formalism is given without doubling the number of independent field variables, as in any integer-spin x^0-formulation happens. The null Hamiltonian is found and it is seen to correspond to the momentum P_+ of the field. Thereafter, the Heisenberg commutation relations for the dynamical variables are computed. Null electrodynamics is also studied starting from the first-order action and the so-called null gauge is discussed. In particular it is shown that its choice is not compulsory. (auth)

19997 GLOBAL SPINOR FIELDS IN SPACE–TIME. Lee, K. K. (Syracuse Univ., NY). Gen. Relativity Gravitation; 4: No. 6, 421-433(Dec 1973).

Space-time manifolds that are space- and time-oriented, causal, and possess spinor structures are considered. Five propositions are proven: If a connected, space- and time-oriented manifold is simply connected, then it is noncompact; if such a manifold is simply connected, it admits a spinor structure, which, moreover, is unique; if the space-like section of M is compact, then there exists a global system of orthonormal tetrads on M; the necessary and sufficient condition for every space-time M whose space-like section is compact to admit a spinor structure is that M have a global system of orthonormal tetrads; every space-time M which can be embedded in R^6 admits a spinor structure. It is further suggested that in view of the fact that the existence of a spinor structure is related to homotopy properties, space-time manifolds may be classified in terms of their homotopy groups $\pi_i(M)$, $i = 1, 2, 3, 4$. In a concluding section, some avenues for future research are discussed. (auth)

REACTOR TECHNOLOGY AND REGULATION

19998 QUICK ACCESS TO NUCLEAR PLANT DATA. Nail, J. H. Jr. Power Eng.; 77: No. 12, 44-47(Dec 1973).

The Nuclear Assurance Corp. has established a computer-based communications network called NORAN (Nuclear Operations Reliability Assistance Network). The system was developed to provide prompt interchange of information, and for computer generation of both internal and AEC-required reports. The plant operator feeds daily information about his nuclear plant into the central data bank. Data input forms are described. (auth)

19999 NUCLEAR POWER IN THE UNITED STATES: PRESENT STATUS AND OUTLOOK. Boggio, G. Euro-Spectra; 12: No. 2, 34-40(Jun 1973).

After an analysis of the problems associated with nuclear power development in the United States, which resulted in delays in plant construction, the present situation is reviewed and future developments are outlined. It is now estimated that by 1985 proven reactors will provide about 30% of all the electric power generating capacity in the USA; since high-temperature gas-cooled reactors and fast breeder reactors should by that time be able to offer a plentiful energy supply, the author concludes that the future of nuclear power in the United States looks more than encouraging. (EU)

20000 RECENT ADVANCES IN REACTOR SYSTEMS. Insch, G. M. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). VGB Kraftwerkstechnik; 53: No. 11, 698-706(Nov 1973).

New developments in reactor systems must aim to secure improvements which are greater than the advantage of replicating systems which are already proven. Features of light-water reactors which today establish criteria for future developments are discussed. For comparative purposes, developments with heavy-water and high-temperature reactors are described. (GE)

20001 SLOWDOWN IN SWEDISH NUCLEAR ENERGY PROGRAM. Ambio; 2: No. 3, 92(1973).

The background for, and significance of, the slowdown in the Swedish nuclear energy program recently decided on in the Ridsdag is discussed. There are no indications of a decline in the energy debate, but it is not clear how this will affect the long term program. (NO)

20002 DEVELOPMENT TRENDS IN CZECHOSLOVAK NUCLEAR POWER STATIONS. Stanek, J.; Komarek, A. Skoda Rev.; No. 4, 37-43(1973).

The status of power reactor development in Czechoslovakia is surveyed. The development of the KS-150 reactor for the Bohunice station is described and current work on PWR type reactors is reviewed. Work aimed at future development of fast breeder reactors is briefly examined. (JWR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 18278, 18286, 18287, 20217, 20229, 20239, 20240, 20299, 20304, 20306, 20337, 20347–20353, 20356–20363, 20365, 20368, 20374–20377, 20387, and 20389.

20003 (IBK-1189) SINOD: A NONLINEAR LUMPED PARAMETER MODEL FOR STEADY STATE, TRANSIENT AND STABILITY ANALYSIS OF TWO-PHASE FLOW IN NATURAL CIRCULATION BOILING WATER LOOPS. Matausek, M. R. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). Oct 1973. 59p. Dep. NTIS (U.S. Sales Only) $5.00.

A nonlinear lumped parameter model is developed for steady state, transient and stability analysis of the two-phase flow in natural circulation boiling water loops. The loop considered consists of an equivalent downcomer and a channel divided into a heated test section and an unheated riser. The model SINOD is formulated in terms of four nonlinear first order ordinary differential equations and one time lag. Since the time lag can be neglected in most analyses, the model reduces to a system of only three nonlinear first order ordinary differential equations. An important particularity of the model is that both the steady state and the dynamic calculations can be performed by solving the same system of differential equations. The input data are the parameters specifying the geometry of the test loop, the physical parameters of the fluid, the channel inlet and the riser outlet pressure drop coefficients. The two-phase friction multiplier and the slip ratio correlations are arbitrary. (18 references) (auth)

20004 (INIS-mf-829) PLUTONIUM ASSEMBLIES IN THE DODEWAARD BWR. Bonet, H.; Deramaix, P.; Stroo, G.; de Burbure, S.; van den Broeck, H.; Mostert, P. (Societe Belge pour l'Industrie Nucleaire, Brussels; Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Gemeenschappelijke Kernenergiecentrale Nederland N.V., Dodewaard). 1973. 4p. INIS.

Since 1967, BELGONUCLEAIRE has pursued for BWR reactors the design of plutonium fuel elements of the island type (i.e., the plutonium rods inserted in the central zone of the bundle and surrounded by enriched uranium fuel rods). Complementarily to plutonium recycle approaches performed within other programs, where either 25% (self-generated Pu) or 100% of the fuel rods of each assembly are containing Pu, BELGONUCLEAIRE designed and delivered two high performance Pu fuel assemblies where 40% of the fuel rods of each assembly contain Pu; these were loaded in April 1971 in the DODEWAARD BWR, owned and operated by GKN (Gemeenschappelijk Kernenergiecentrale Nederland). (auth)

20005 (ORNL-TM-4443, pp vp Paper 17) CONSIDERATIONS IN THE DEVELOPMENT OF SIMPLIFIED BWR CORE SIMULATORS. Specker, S. R. (General Electric Co., Schenectady, NY). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The degree of detail required of a nuclear core simulator is dependent upon the range of applications for which it is intended. A large BWR core requires a three-dimensional simulation model for the accurate prediction of the effects of operating variables on core performance. However, it is neither practical nor necessary to couple such a detailed nuclear-thermal-hydraulic-fuel cycle model with a power system integration model. The important parameters which measure fuel cycle performance can be predicted with sufficient accuracy using approximate models which reduce the dimensionality of the neutronics solution by introducing correlations to accurate three-dimensional coupled nuclear-thermal-hydraulic fuel cycle models. Results of detailed three dimensional calculations are presented to identify the important three-dimensional effects which must be accounted for in a simplified BWR core model. The effect of the nonuniform axial power distribution on core performance is shown to be of particular importance. The need for accurate calculation of the steam void distribution is discussed. (5 references) (auth)

20006 (SWRI-2154-P-11-26) EVALUATION OF LACBWR VESSEL STUD REPLACEMENT MATERIAL. Topical Report No. 17. Norris, E. B.; Pickett, A. G. (Southwest Research Inst., San Antonio, Tex. (USA)). 19 Oct 1973. Contract AT(11-1)-2154. 25p. Dep. NTIS $3.25.

In support of an analysis of failures of two LACBWR vessel closure studs, fatigue crack growth data was developed for the replacement material in several environments related to plant operations. None of the environments studied reduced the fatigue crack propagation resistance below the range of values expected for high strength quenched and tempered steels. Stress analysis has previously demonstrated that the fatigue life of the replacement studs would be adequate for programmed service excluding the potential effects of corrosion on fatigue life. These program results eliminate that element of concern. There appears to be no reason to amend the inservice inspection program from the standpoint of corrosion effects. (auth)

20007 VENTILATION AND HEATING SYSTEMS IN THE MUEHLEBERG NUCLEAR POWER PLANT, SWITZERLAND. Meuter, R.; Mueller, E. (Muehleberg Nuclear Power Plant, Switzerland). Sulzer Tech. Rev.; 55: No. 3, 167-180(1973).

20008 CRACKS AT THE JOINT OF THE MAIN-STEAM PIPE TO THE PRESSURE RELIEF PIPES IN THE WUERGASSEN NUCLEAR POWER PLANT (KWW). IRS Mitt.; No. 1, 4-9(1973). (In German).

On 25.2.73, cracks were found in the welded joint region between the main-steam pipe and the pressure relief pipe during the starting operation of the nuclear power plant, Wuergassen. A leak of about 400 l/h was measured. The discovery of the damage, the investigation results and the further procedure in this accident are described. (GE)

20009 CONSTRUCTION OF THE CAORSO NUCLEAR POWER STATION. Nucl. Eng. Int.; 18: No. 211, 943-948(Dec 1973).

The selection of a BWR reactor for the 840 MW(e) nuclear power station at Caorso is discussed. Many of the interesting design fea-

tures are emphasized. Some of these classify the reactor as a BWR-4 but there are differences in several features. Among the latter, which are briefly discussed, are the type of pressure suppression containment, the full flow dimineralization system, the large civil engineering structure and fuel pool, and the emergency core cooling system. The role of the various contractors is summarized. A coloured wall-chart showing a cutaway diagram of the station and giving parameters is included. (UK)

20010 ECCS RULE-MAKING HEARING. Cottrell, W. B. (Oak Ridge National Lab., TN). Nucl. Safety; 15: No. 1, 30-55 (1974).

The genesis, exposition, and some of the ramifications of the ECCS Rule-Making Hearing, Docket RM-50-1, are reviewed. When the AEC promulgated the Interim Acceptance Criteria (IAC) in June of 1971, a series of events was initiated which is still being felt by the nuclear community. This article examines briefly what the emergency core-cooling system (ECCS) is and how it performs in both PWRs and BWRs, as well as the results of the various studies and research and development (R&D) programs that were extant at that time. The resulting controversies following publication of the IAC precipitated the hearing, which began Jan. 27, 1972, and ended July 25, 1973. The course of the hearing and the AEC concluding statement—in effect, proposed revised criteria—are summarized. Although the proposed criteria have not yet been adopted, the ramifications of the hearing include a review and redirection of R&D programs, contemplated derating of some existing plants, and new reactor designs by the vendors. The author concludes that the hearing was a necessary and constructive, if traumatic, experience. 61 references. (auth)

20011 EVALUATION OF INCIDENTS OF PRIMARY COOLANT RELEASE FROM OPERATING BOILING-WATER REACTORS. Nucl. Safety; 15: No. 1, 76-79(1974).

The report evolving from a review of eight incidents of primary coolant releases from eight operating boiling-water reactors by a seven-member group from the AEC Directorate of Licensing and Directorate of Regulatory Operations is described. Included are sources for obtaining the report and the complete section on conclusions and recommendations. (auth)

20012 TWO INTERESTING PHENOMENA OBSERVED IN THE AXIAL POWER DISTRIBUTION OF A BWR. Shimooke, T. (Japan Atomic Energy Research Inst., Tokai). Nucl. Technol.; 21: No. 2, 99-110(Feb 1974).

Two interesting phenomena were observed in the axial power distribution in the core of the Japan Power Demonstration Reactor. One is the control-rod and void coupled bump on the axial power shape; this is a kind of local power peaking produced by the interacted effect between the partially inserted control rod and the axial void changes in the moderator. The other may be termed a "burnup oscillation of the axial power distribution"; this is a long-term, periodic change of the axial power distribution due to core exposure and to the withdrawal of the control rods. It is found that the upper and lower half-channel integrations of the local leakage of thermal neutrons are essential factors for the occurrence of those phenomena. 9 references. (auth)

20013 DOUGLAS POINT BWR/6: A SPECIAL SURVEY OF A POWER STATION UTILIZING THE GE BWR/6 DESIGN. Thompson, R. W.; Stinson, L. A.; Scoville, J. J.; Dragoumis, P.; Gee, W. R.; Wilton, A. N.; Rosen, A.; Cooper, K.; Jacobson, J.; Steinert, L. A.; Koke, L. C.; Hendon, H. H. Nucl. Eng. Int.; 18: No. 210, 869-883(Nov 1973).

A survey comprising eight articles is presented on the 2356 MW(e) nuclear station to be built at Douglas Point Washington, for which the Potomac Electric Power Company have selected General Electric's advanced BWR/6 reactor in two 1178 MW(e) units. Four articles briefly cover the background to the choice of station from the point of view of economics, aesthetics, environmental advantages, the techniques of site selection, also planning and program control. More detailed articles describe reactor design, fuel and fuel handling, safety, and station control. Main parameters for the core and details of the standardized modular components, which are assembled in a single pressure vessel, are given. Key features which distinguish BWR/6 from BWR/5 are emphasised. The fuel handling system provides for a 4.4 days per year refuelling outage. Fuel is transferred between two pools one in the reactor building and the other in the fuel handling building. The principle safety features described are the containment system which is more compact, has improved seismic response and will offer significant reductions in dose levels during accident situations, and the emergency core cooling system. In the control room, digital and multiplex data transmission systems will be used and cathode ray tubes for display. A coloured pull-out wall chart showing a cut-away diagram of the plant and existing main parameters is included. (UK)

20014 CAORSO NUCLEAR POWER STATION. Sani, L. (Ente Nazionale per l'Energia Elettrica, Milan). Nucl. Eng. Int.; 18: No. 211, 941-943(Dec 1973).

The nuclear power station under construction at Caorso near Pacenza, Italy is equipped with a BWR type reactor with a pressure-suppression primary containment system built in reinforced concrete and lined with welded steel plate. Main parameters are tabulated and an outline is given of station layout, buildings, seismic and environmental problems, and licensing. (UK)

20015 NEW BOILING-WATER REACTOR CONCEPT (DESIGN 72) WILL FACILITATE THE LICENSING PROCEDURE. KWU-Rep.; No. 11, 1-4(1972). (In German).

The new design is characterized by a greater safety margin and improved operation and maintenance availability; one of its main features is the containment vessel which has been designed as a cylindrical vessel with an inner steel liner. Some other new design features are: simplified and hence more safe after-heat removal, enhanced power density in the core, and reduced stress on the fuel rods, as well as some further improvements of the recirculating pumps situated within the reactor building. (GE)

20016 DEVELOPMENT OF A PRE-STRESSED CONCRETE PRESSURE VESSEL FOR LIGHT-WATER REACTORS AND ACCESSORY COMPONENTS. Bremer, F.; Fuerste, W. (Krupp (Friedr.) GmbH, Essen). Tech. Mitt. Krupp, Forschungsber.; 31: No. 3, 71-78(1973). (In German).

A description is given on the commercial chances of the prestressed concrete pressure vessel for power generating units from 300 to 1200 MW(e), and a reference design of a pressure vessel for boiling water reactors is presented. Structural details of liner, insulation, and penetrations are explained, stress distribution in pressure vessel and liner are investigated, and safety aspects are considered. In addition, tests with liner, insulation, and concrete are described. (GE)

20017 THERMOTECHNOLOGY IN NUCLEAR POWER PLANTS: PROBLEM AREAS IN CONSTRUCTION OF PRESENT DAY LARGE TURBINE SETS. Aulie, N. J. (A.S. Norsk Elektrisk and Brown Boveri, Oslo). Tek. Ukebl.; 1200: No. 43, 47-52(18 Oct 1973). (In Norwegian).

In nuclear power plants using PWR or BWR type reactors the low steam conditions lead to the use of physically much larger turbine sets than in conventional base load plants. Superheating cannot be used and the steam is nearly always wet. The large steam volumes for a given power output necessitate very large turbine blades at the LP exit and this is the limiting factor in design. The condenser vacuum plays an important role in the design optimization. The water separator/reheater is an important component as are the feedwater heaters in the thermal economy of the steam cycle. The feedwater pumps do not require the same effect as in a conventional plant, due to the lower pressure. Both turbine and electric pumps may be used. The dimensions of the generator are limited by dynamic stresses and transport problems. Higher magnet effects attained in rotors can lead to vibrations and deformations. Hydrogen cooling of the rotor windings and water cooling of the stator windings are at present used, but full water cooling may allow a 20% reduction in size. 4-pole machines do not offer new problems and the rotors are in many ways technically simpler. However, the stator weight of a 1300 MW stator can be 400 tons and transport problems arise. (NO)

20018 VENTILATION PLANTS IN THE NUCLEAR POWER PLANT MUEHLEBERG, SWITZERLAND. Meuter, R. (Sulzer Bros. Ltd., Winterthur, Switzerland). Klima Kaelteing.; 1: No. 9, 43-50(1973). (In German).

The atomic power station Muehleberg, Switzerland has a generator performance of 306 MW and has become the first boiling water reactor of Switzerland after the inauguration of the presurized-water reactors, the atomic power station Beznau I and II. Described are the ventilating plants for the reactor and preparation buildings, and the requirements they have to fulfill, the supply and extract plants, the operational conditions in the reactor building, installations, emergency plant, recirculating air conditioning equipment for the drywell together with the demands, machine room ventilating plant, plant testing, filtration plant and putting into operation. Tests of the completed plant have proved that the installation fulfills all requirements demanded. (GE)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 20010, 20017, 20214, 20217, 20289, 20333, 20337, 20338, 20344–20346, 20354, 20355, 20364, 20366, 20367, 20369–20373, 20378, 20379, and 20387.

20019 (INIS-mf-826) REACTOR PHYSICS SUPPORT TO THE STUDY OF FUEL PERFORMANCE AND PLUTONIUM RECYCLE IN SENA. Debrue, J.; Leenders, L.; Motte, F.; van den Broeck, H. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1973. 6p. INIS.

Since its start the Belgian plutonium recycling physics program has shown a particular interest for the case of the SENA reactor. This was clearly reflected by the choice of the geometrical and fuel composition characteristics of the VENUS critical facility in which the plutonium recycling studies have been carried out. After a large basic program performed in VENUS to obtain a set of reference data for checking reactor code accuracy when treating plutonium assembly design problems at the start of life, the same facility has been and still is used for the study of so-called mock-up configurations, simulating as closely as possible actual reactor assembly characteristics. It has been recognized that an important problem remaining for reactor code calibration is the prediction of burnup and the evolution of other fuel characteristics with time; this is true for UO_2 as well as for UO_2–PuO_2 fuel. A first step to produce SENA reference data has been the launching of a physics program in collaboration between the French CEA and the Belgian Association Belgonucléaire–SCK/CEN, devoted to postirradiation experiments on one of the highest burnup fuel assemblies of each of the first three unloaded SENA batches. (INIS)

20020 (INIS-mf-833) PLUTONIUM RECYCLE IN CRUCIFORM CONTROL ROD PWR'S. Bairiot, H.; Dewandeleer, J.; Lafontaine, I.; Charlier, A. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1973. 3p. INIS.

The first generation PWR plants present attractive features for Pu recycle. Their cruciform water slots for control rods tend to isolate the new assemblies from their neighbours, allowing a progressive shift from a U burner to a Pu one, or inversely (if justified by a Pu price increase). If stainless steel clad, the relatively high enrichment further favours the economics of Pu recycle. Detailed Pu recycle studies were performed for the SENA reactor, adopting some assumptions concerning the Pu origin (the reactor itself), the equilibrium cycle duration (to remain unaffected), the form factors (unaffected DNB margins), the UO_2 fuel rod enrichment (identical to standard reload fuel). Confidence in the calculation methods was obtained by studying configurations representing one or more SENA recycle assemblies in VENUS. Pu fuel of identical specifications has been and is still being irradiated in BR 2 in instrumented capsules or non instrumented baskets. Postirradiation examinations on samples having reached 60,000 MWd/tM and having experienced 60 power cycles and linear ratings up to 700 W/cm have indicated the perfect behaviour of the fuel; a length increase of 0.1% and a diameter increase of only 0.2% have been recorded. (INIS)

20021 (ORNL-TM-4443, pp vp Paper 19) EFFECT OF REFUELING DECISIONS AND ENGINEERING CONSTRAINTS ON THE FUEL MANAGEMENT FOR A PRESSURIZED WATER REACTOR. Rieck, T. A.; Benedict, M.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The principal objectives of this study were to determine the limitations imposed on feasible variations in the cycle-to-cycle energy by engineering constraints and to evaluate the economic effects of the feasible variations. Thus the effects of variations in both reload batch size and enrichment on cycle energy potential, limiting engineering parameters and fuel cycle costs were studied. Since each commercial nuclear reactor type behaves differently to reload fuel decisions and a detailed analysis of all commercial reactor types is an impossible task for a project of this type, this investigation was limited to analyzing a typical class of pressurized water reactors (PWR) of approximately 1000 MW(e) capacity. The Zion-I PWR designed and built by Westinghouse and owned by the Commonwealth Edison Company was chosen for this analysis. Although there are differences between this type of PWR and other commercial reactor types, the general conclusions and insights gained in this analysis can also be extended to these other reactor types and sizes. (10 references) (auth)

20022 QUALITY CONTROL OF PUMPS FOR NUCLEAR APPLICATIONS. Vuckovic, M. (Ateliers de Constructions Electrique, Charleroi, Belgium). ACEC (Ateliers Constr. Elec. Charleroi) Rev.; No. 2, 21-28(1973). (In French).

The new generation of primary pumps for PWR-type reactors have evolved rapidly resulting in groups with a classical electric motor involving pumps with controlled leaks with higher and higher power. The present control techniques have followed and even preceded this evolution. The various quality control agencies during development of the groups and notably the project revision, the study of the control plan bases and of the control equipment, the activities of the control laboratory, metrology, and inspection, and testing are all reviewed. This very complete series makes it possible to simulate the actual operational conditions of the motor-primary pump groups. An extract is given from the "Pump Quality Control Manual" defining the quality control policies of the ACEC-POMPES. (tr-auth)

20023 METHOD WITH IMPROVED ACCURACY FOR THE DETERMINATION OF NUCLEAR FUEL BURNUP USING BURNABLE POISONS. Schaechter, L.; Hacman, D.; Mot, O. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 7, 875-885(1973).

A method with improved accuracy for the determination of the burnup using some additional burnable poisons in the fuel was employed. Irradiations of 40 fuel elements with or without burnable poison were also carried through. The determinations were performed by means of a high resolution gamma spectrometry equipment. Some estimated calculations are presented regarding the effect of the burnable poison in a PWR-440 MW(e) type reactor. (6 references) (auth)

20024 RWE: PACE-MAKER FOR THE INSTALLATION OF NUCLEAR POWER PLANTS. Energ. Tech.; 25: No. 9, 242-243 (1973). (In German).

The present state of the construction of the nuclear power station BIBLIS, two units with a total of 2,440 MW(e), is described. Two cooling towers will be installed for each unit instead of the originally planned fresh water cooling systems. Unit A will go into operation approximately July 1974, unit B about two years later. At the building site, an information center for the general public has been set up. (GE)

20025 TECHNICAL IMPROVEMENTS OF THE KWU PRESSURIZED WATER REACTOR. Consolidation of the State of Development Achieved So Far. KWU-Rep.; No. 13, 1-5(1973). (In German).

A description of the building method and equipment of the modern pressurized water reactors and a survey on the existing and planned PWR type reactors are given. (GE)

20026 MODEL TEST ON RIVER WATER CONTINUOUS FLOW COOLING FOR A NUCLEAR POWER PLANT. Mosonyi, E. (Univ., Karlsruhe, Ger.). Energie; 25: No. 10, 299-301(Oct 1973). (In German).

The tests described have been made for the planned Gemeinschaftskernkraftwerk Neckar (GKN). The basic conditions governing these model tests, the model design, the measuring methods, and the experimental program are described. (GE)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstract 20292.

20027 (COO-2267-6) ASSESSMENT OF BEHAVIOR AND DESIGN OF STEEL LINERS FOR CONCRETE REACTOR VESSELS. Final Report. Lee, T. T.; Gurbuz, O. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Dec 1973. Contract AT(11-1)-2267. 51p. Dep. NTIS $4.75.

A procedure for the accurate independent assessment of the design and performance of steel liners for concrete reactor vessels is described. Descriptions presented include current design practice, evaluation of current design practice, design review information requirements, and design review guidelines. (55 references) (JWR)

20028 (GERHTR-63) LIMITS OF BURNUP-DOSE LOADING OF PYROCARBON-COATED PARTICLES. Rotterdam, R. (Hochtemperatur–Reaktorbau G.m.b.H., Mannheim (F. R. Germany); Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1973. 8p. Dep. NTIS $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

The limits of the burnup-dose loading of PyC coated $(U,Th)O_2$ fuel particles were previously investigated. The particles were heated to 1500°C without showing damage. Theoretical burnup-dose loading limits were investigated. A comparison between the maximum tensile stress and the tensile strength of PyC showed that the particles need not be expected to fail even with very high burnup. However, until permissible creep expansion values are obtained, the life expectation of the particles can not be assessed. (FS)

20029 (GULF-GA-A-12499) AFTERHEAT CALCULATIONS FOR THE HTGR. Sund, R. E. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Nov 1973. 47p. Dep. NTIS $4.50.

Afterheat rates were calculated for the HTGR utilizing new input information. The new afterheat results are a few percent higher than the HTGR afterheat results previously obtained in the 100-to 10,000-sec time range and are 11 to 15% higher than the previous results in the one-day to ten-days time range. The uncertainties were studied in the time region from 100 sec to ten days. The new results were also compared with calculations at other laboratories. The gamma-ray spectra were computed at several shutdown times for future applications in shielding studies. Previous afterheat calculations for the HTGR are completely replaced and updated. (auth)

20030 (GULF-GA-A-12652) NUCLEAR DESIGN METHODS AND EXPERIMENTAL DATA IN USE AT GULF GENERAL ATOMIC. Merrill, M. H. (Gulf General Atomic Co., San Diego, Calif. (USA)). Jul 1973. 364p.

A general review of the nuclear design methods in use at Gulf General Atomic (GGA) is given and descriptions of reactor physics computer codes are presented. The experimental data from critical assemblies and operating reactors which confirm these methods and the nuclear cross section data used with them are reviewed in detail for the High-Temperature Gas-Cooled Reactor (HTGR), and briefly discussed for other reactor types designed or studied at GGA. (auth)

20031 (GULF-GA-A-12725) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING AUGUST 31, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 28 Sep 1973. Contract AT(04-3)-167. 249p. Dep. NTIS $7.60.

The High-Temperature Gas-cooled Reactor (HTGR) work reported includes studies of basic fission-product distribution mechanisms, recycle fuel studies (including designing and testing of recycle test elements) and exploration of head-end reprocessing methods (as part of a national recycle plan and of a recycle fuel plan), and physics and fuel management studies. Materials studies include irradiation and analysis of fuel particles in capsules to evaluate fuel systems, and basic studies of control materials and of carbon and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

20032 (GULF-GA-A-12818) HTGR BASE PROGRAM. Quarterly Progress Report for the Period Ending November 30, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 28 Dec 1973. Contract AT(04-3)-167. 131p. Dep. NTIS $5.45.

The High-Temperature Gas-cooled Reactor (HTGR) work reported includes studies of basic fission-product distribution mechanisms, recycle fuel studies (including designing and testing of recycle test elements) and exploration of head-end reprocessing methods (as part of a national recycle plan and of a recycle fuel plan), and physics and fuel management studies. Materials studies include irradiation and analysis of fuel particles in capsules to evaluate fuel systems, and basic studies of control materials and of carbon and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented. (auth)

20033 (GULF-GA-B-12340) FORT ST. VRAIN PROOF TEST ELEMENT NUMBER TWO DESIGN, FABRICATION, AND ASSEMBLY REPORT. Scheffel, W. J.; Disselhorst, B. F.; Langer, S. (Gulf General Atomic Co., San Diego, Calif. (USA)). 21 May 1973. Contract AT(04-3)-633. 161p. Dep. NTIS $10.25.

As part of the overall fuel element research and development program for the Public Service Company of Colorado Fort St. Vrain Nuclear Generating Station, Unit One Reactor, one or more prototype proof test fuel elements are to be irradiation tested in a high-temperature gas-cooled reactor (HTGR) environment. The design details, fuel characteristics, and assembly of the second proof test element (PTE-2) in a series of five prototype proof test elements built for the Fort St. Vrain Nuclear Generating Station are described. The purpose of the fuel element irradiation program is to demonstrate that the Fort St. Vrain (FSV) fuel element will meet its design objectives. This will be demonstrated by irradiating a test element(s) in the Peach Bottom HTGR at temperature gradients typical of that expected in FSV to at least one-third of the design lifetime fuel burnup. PTE-2 will achieve the desired total burnup in approximately 300 full-power days of irradiation in Peach Bottom. It should be noted that PTE-2 was built in 1968, prior to the introduction of pitch-bonded, natural-flake graphite matrix which was eventually chosen for use in the FSV initial core. (25 references) (auth)

20034 (JUL-1000-RB) FLOW THROUGH BENDS OF CIRCULAR CROSS SECTION. Achenbach, E. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Sep 1973. 43p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

In order to obtain fluid dynamic data for the design of the thermal insulation mounted in the bends of the hot ducts of a high temperature gas-cooled reactor the local static pressure was measured at the walls of bends with circular cross section. The angles of deflection were $\rho = 90°$ and $\rho = 180°$. The ratio of curvature radius to bend diameter R/d has been varied in the range $1.3 < R/d < 2.5$. The diameters of the bends tested were d = 50, 70 and 150 mm. Thus the Reynolds number could be varied from $Re = 2 \times 10^4$ to $Re = 3 \times 10^5$ in connection with a variation of the fluid velocity. The local pressure distribution can be described by the results of the potential theory except at the region of the inner contour of the bend. Diagrams were reported on the basis of the theory and experiments which allow one to determine the maximum pressure differences across the cross section as well as the static pressure profiles. It is pointed out which conditions must be taken into account constructing a thermal insulation for bends of a high temperature reactor from the fluid mechanical point of view, if the insulation is already designed according to thermal requirements. By means of an exemplary calculation it is demonstrated that pressure differences of about 1 bar occur within a bend of a high temperature reactor, if the calculation is based on the just projected dimensions of the hot ducts and on the admissible fluid velocities. (auth)

20035 DELMARVA HTGRs. Nucl. Eng. Int.; 18: No. 210, 890-892(Nov 1973).

The Summit nuclear power station to be built for Delmarva Power and Light Company, 2 miles S. of the Chesapeake and Delaware Canal, will consist of two 770 MW(e) HTGR systems which are advanced larger versions of Fort St Vrain. Parameters and some details of the prestressed concrete pressure vessel and the coolant system are given. Brief reference is made to control rods and fuel loading. (UK)

20036 INDUSTRY POLICY ASPECTS OF THE HIGH-TEMPERATURE REACTOR DEVELOPMENT. Technol.-Nachr. Manage.-Inform.; No. 120, A–E(1973). (In German).

A short description of the activities in the FRG and of the planned industrial cooperation of Gulf and BBC is followed by short outlines concerning the following items: THTR 300 state of construction, HTR power plant with large-scale power, HHT development and process heat generation by means of HTR. (GE)

20037 SAFETY OF GAS-COOLED FAST REACTORS. Kovalevich, O. M. (Inst. of Atomic Energy, Moscow). pp 307-324 of Gas-Cooled Fast Reactors. Vienna; International Atomic Energy Agency (1973). (In Russian).

From proceedings of the IAEA study group meeting sponsored by the USSR State Committee on the Utilization of Atomic Energy Minsk, USSR (24 Jul 1972).

The criteria of safety for gas-cooled power reactors are enumerated. A table of the possible accidents, expected consequences of these accidents, and a tabulation of safety devices are reported. Those examined in detail are: disconnecting and failures of gas blowers, rupture of the primary circuit, melting of the core, and energy release in the form of explosions. (tr-auth)

20038 DETECTION OF DEFECTIVE SiC LAYERS IN COATED NUCLEAR FUEL PARTICLES. Hewette, D. M. II; Laing, W. R. (Oak Ridge National Lab., TN). Nucl. Technol.; 21: No. 2, 149-150(Feb 1974).

A technique has been developed for detecting defective SiC layers in silicon carbide-pyrolytic carbon coated fuel particles. The outer coating of carbon is burned off at 800°C, and the particles are pressurized at 1000 lb/in.^{2} in a mercury porosimeter. Mercury is forced through any defects in the SiC layer and into the porous carbon. The particles are examined by a low-voltage microradiographic technique. Defective particles were detected in some batches of coated fuel particles. 4 references. (auth)

20039 NUCLEAR REACTOR FUEL ELEMENT ASSEMBLIES. Rapier, A. C. (to United Kingdom Atomic Energy

Authority). British Patent 1,327,666. 22 Aug 1973. Filed Date 17 May 1971. 5p.

Reference is made to fuel element assemblies for use in high temperature gas cooled reactors. In existing designs of HTR fuel element assemblies heat transfer is far less efficient than it could be and a large allowance has to be made for systematic and random temperature variations from the nominal design values. The fuel element assembly described comprises a prismatic graphite block containing a number of parallel tubular fuel elements supported on a baffle located at one end of the block. The baffle is arranged to obstruct coolant flow over the outer surfaces of the fuel elements and to direct flow through the central passageways. The fuel elements may comprise annular compacts containing fissile material, closely fitted to a tubular mandrel that defines the axial passageway for coolant flow. The coolant passageways are generally uniform in cross-section and remain substantially unchanged by shape variations in service, and the size of the bores for optimum heat transfer is relatively simple to calculate, enabling heat transfer efficiency to be increased. Several alternative constructions are described. (UK)

20040 GAS-COOLED REACTOR. Bridge, H.; Kelly, B. T. (to United Kingdom Atomic Energy Authority). German Patent 1,439,794. 11 Jan 1973. 5p. (In German).

The reactor containing a graphite moderator structure is composed of graphite units. The graphite parts, which have a normal operating temperature of above 300°C, exhibit a macroscopically measured coefficient of thermal expansion, at least in a given direction, which is greater than 4.5×10^{-6}/°C, where the coefficient is measured in the range of –196°C to +20°C. (GE)

20041 INITIAL EVALUATION OF THE HIGH-PRESSURE TESTS ON A THTR 1:5 MODEL. Bindseil, P. (Krupp (Friedr.) GmbH, Essen). Tech. Mitt. Krupp, Forschungsber.; 31: No. 3, 113-124(1973). (In German).

For the purpose of planning the prestressed concrete reactor vessel for the THTR nuclear power station a 1:5 scale model of the vessel was built, instrumented, and tested. Strain measurements under cyclic stresses due to internal pressure and temperature were made with the aid of strain gauges and load cells. The purpose of the test was to compare the theoretical results with the measured values, to investigate the elastic behavior of the vessel and the ultimate load condition, and to determine crack patterns and consequences for the final fracture behavior of the vessel. Evalautions of the tests conducted at pressures up to 84 atmospheres were performed using an IBM computer routine. (GE)

20042 HIGH TEMPERATURE REACTOR FUEL ELEMENTS: WHERE DO WE STAND TODAY? Krawczynski, S. J. B. (Kernforschungsanlage Juelich GmbH, Ger.). Atomwirt., Atomtech.; 18: No. 11, 521-524(Nov 1973). (In German).

Current problems of the fuel cycle concerned with the requirements on fuel elements for high temperature reactors (HTR) and the experience so far gained in their manufacture and use in reactors are discussed. A major part of the discussion of some importance in the Federal Republic concerned the relative advantages and disadvantages of the two different forms of fuel element, the prismatic block of the GA element and the sphere used in the German THTR. Opinion was heavily in favor of further developing both forms, not least because of the future use of the HTR for the generation of process heat. (GE)

20043 ARCHITECTURE OF THE SUPPORTING STRUCTURE OF A NUCLEAR REACTOR. Madilian, E.; Martin, R.; Petit, G.; Remoleur, J. (to Commissariat a l'Energie Atomique). French Patent 2,131,886. 1 Apr 1973. 7p. (In French).

A design is presented for the support of the core structure and cover of a direct cycle (downward gas coolant flow) high temperature nuclear reactor. This design enables the hot gas collecting circuit to be as short as possible. Two openings are provided to serve as gas collectors, the part of the core situated above the gas collectors being supported by an assembly of refractory parts operating only under compression and shear forces. The assembly is constructed to allow the free flow of gas and is supported by the resistant structure of the vessel through intermediate rollers which permit small relative displacements. (FR)

20044 PROMISE OF THE HOT REACTOR. de Bacci, M. (Organization for Economic Co-operation and Development, Winfrith, Eng.). New Sci.; 61: No. 879, 20-22(3 Jan 1974).

By virtue of its entirely ceramic core and its inert coolant (helium), the HTR can produce outlet gas temperatures of the order of 900° to 1000°C. The potential use of heat at such temperatures opens entirely new horizons to the penetration of nuclear energy into the total energy market. Electricity could be produced more efficiently by adopting the reactor coolant as the working fluid to operate a helium turbine. While the intrinsic simplicity of the layout and ancillary plant should eventually yield capital savings, thermal efficiencies could rise well above the levels achievable with steam power plants. Due to the relatively high heat rejection temperatures encountered in gas turbine plants a further advantage for the environment would arise from dry cooling towers, thus avoiding thermal pollution of waters, and broadening the choice of sites for power stations. The waste heat could be employed for industrial use or domestic heating permitting a better overall management of heat. The HTR is being proposed for a variety of applications involving high temperature process heat as the principal product and electricity as a by-product. Possible applications include: (a) production of hot hydrogen and electricity for nuclear powered steelworks; (b) production of hydrogen by reforming reactions between water and hydrocarbons, the product being consumed by the heavy metallurgical and chemical industries; (c) manufacture of gases or liquids from low-grade solid fossil fuel deposits, such as high sulphur coal, lignite, oil shale and tar sands, to yield higher grade fuels which can be distributed to relatively distant markets. (UK)

20045 HIGH TEMPERATURE GAS COOLED REACTOR FUEL ELEMENTS. De Bacci, M.; Acciarri, P. (to United Kingdom Atomic Energy Authority). British Patent 1,330,031. 12 Sep 1973. Filed date 22 Mar 1971. 4p.

The fuel element described comprises a tubular member composed of a number of fuel-containing annular disks superimposed one on the other, with provision for coolant flow between at least some of the adjacent disks. The disks comprise one or more layers of fission product retaining fuel particles embedded in graphite or other matrix material shaped to allow coolant to sweep between the faces of adjacent disks. It is preferred that the disks contain two layers of coated fuel particles fixed in matrix material. (UK)

20046 NUCLEAR POWER POLICY. House of Commons Paper No. 350, Session 1972–73. London; Her Majesty's Stationery Office (1973). 6p.

The following aspects of United Kingdom nuclear power policy are dealt with: the structure of the nuclear design and construction industry; the appointment of the Nuclear Power Advisory Board; proposals for an early (i.e., 1974) nuclear power station order; future of the High Temperature Reactor and Steam Generating Heavy Water Reactor; and the position of the Chief Inspector in the Nuclear Installations Inspectorate. (UK)

20047 CONSIDERATIONS ON THE BEHAVIOR OF PRESTRESSED CONCRETE PRESSURE VESSELS UNDER ULTIMATE LOAD CONDITIONS AND ITS INFLUENCE ON CALCULATION AND DESIGN OF THTR VESSELS. Bindseil, P. (Krupp (Friedr.) GmbH, Essen). Tech. Mitt. Krupp, Forschungsber.; 31: No. 3, 89-98(1973). (In German).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A description is given on the design of the pre-stressed concrete pressure vessel on the basis of the service and ultimate load conditions. Verification is given of the ultimate load-bearing capacity (computational requirements, established of a rupture model, calculation by the finite-element method). Moreover the proof of liner integrity with results for liner, liner anchors, and reinforcement is explained. (GE)

20048 REVIEW OF DEVELOPMENTS IN TURBULENCE THEORY. Leslie, D. C. (Queen Mary Coll., London). Rep. Progr. Phys.; 36: No. 11, 1365-1424(1973).

Turbulence theory is difficult because the Navier–Stokes equations are an unclosed set of statistical relations. The problem of closure shows that this problem is evaded rather than solved by the methods now used for practical calculation: examples of the use of these methods are given. The bulk of the review is devoted to more fundamental procedures whose aim is to find the dependence of the pair correlation function on the separation of the two measuring points in space and time. This is done by making closure assumptions which are, at the least, free from arbitrary constants and which have some claim to uniqueness at the lowest level of complexity. The application of these theories to homogeneous isotropic turbulence is described. It is shown that they give a value of the Kolmogorov constant, and a shape for the dissipation range spectrum, which are in good agreement with experiment. The difficulties of applying these more fundamental procedures to practical problems are described, and a way of overcoming them is outlined. The review closes with an account of a problem in nuclear engineering, the calculation of flow and heat transfer in the fuel element of the Advanced Gas-Cooled Reactor, which high-

lights both the defects of existing methods of calculation for turbulent flows, and the need for the better methods that the more fundamental procedures may one day offer. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 18099, 20046, and 20305.

20049 (AECL-4440) REACTIVITY COEFFICIENTS IN A NATURAL URANIUM CARBIDE FUELLED, HEAVY WATER MODERATED, ORGANIC LIQUID COOLED REACTOR. Hamel, D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Nov 1973. 70p. Dep. NTIS (U. S. Sales Only) $5.50. AECL $1.50.

Temperature coefficients of reactivity for an 18-element reference design of a natural uranium carbide fuelled, heavy water moderated reactor, cooled with an organic liquid, are calculated. The physical processes which determine magnitude and sign of the coefficients are identified and discussed. Results are given for fresh fuel containing equilibrium concentrations of the fission products Rh-105, Xe-135 and Sm-149 as well as for fuel with an exposure of 1.2 n/kbarn containing appropriate concentrations of twenty separate fission products and two pseudo fission products. For the fresh fuel condition the fuel temperature coefficient of reactivity is negative. However the magnitude of the coefficient decreases from 1.18×10^{-5} to 0.85×10^{-5} [$°C^{-1}$] as the fuel temperature rises from 600°K to 1000°K. As plutonium builds up under irradiation the fuel temperature coefficient is still negative over most of the temperature range, but its magnitude is much smaller (-0.34×10^{-5} $°C^{-1}$ at 600°K). The coolant temperature coefficient of reactivity for fresh fuel and a coolant temperature of 650°K is $+1.40 \times 10^{-5}$ [$°C^{-1}$]. For irradiated fuel this coefficient becomes $+9.60 \times 10^{-5}$ [$°C^{-1}$]. (auth)

20050 (AECL-4606, pp 10-12) NEW APPROACH TO FRETTING IN NUCLEAR FUEL ASSEMBLIES. Lane, A. D.; Card, D. C. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Win 1973.

Fuel and channel fretting can be a cause for concern in pressure tube type reactors, and can be a factor limiting the power output of these reactors. An approach to this problem area has been adopted which is based on the identification of the various parameters involved, the development of experimental techniques for monitoring them, and the evolution of analytical procedures for predicting their occurrence. (auth)

20051 (AECL-4659) REQUIRED TECHNOLOGICAL BASE FOR HIGH-RELIABILITY NUCLEAR POWER PLANTS. Perryman, E. C. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

The development of a successful nuclear power system demands a strong technological ability within the country and especially within its secondary industry. Factors requiring this ability include the necessity of scaling up equipment size and the development of highly reliable components. The problems involved in maintenance in a power reactor are discussed and also the effect of reactor type on reliability. The technique used at Atomic Energy of Canada Limited to stimulate growth of technological ability within industry is described. (auth)

20052 (INIS-mf-927) TRANSIENT BEHAVIOUR OF RAJASTHAN ATOMIC POWER STATION UNDER LOAD AND REACTIVITY CHANGES. Chamany, B. F.; Murty, I. G. K.; Ray, R. N.; Sastry, S. R. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Digital simulation of process system to study the behavior under unsteady conditions due to various perturbations in steady operation on the CDC-3600 computer has been done for the Rajasthan Atomic Power Station. The model generated for the digital simulation of the dynamics is used to study reactivity steps, ramps, load rejections, and pick-ups of various magnitudes. To improve the plant response to load transients, a power plant controller scheme is suggested. The plant behavior with and without the suggested controller is presented. The model accounts for plant process and instrument time constants and transport lags. (INIS)

20053 REACTOR SAFETY TESTS AT MARVIKEN COMPLETED. Nucl. Eng. Int.; 18: No. 210, 892-894(Nov 1973).

Preliminary results are reported for full scale blowdown and containment tests carried out in the Marviken reactor as part of a multinational reactor safety program. An outline is given of the program and the background to the project. The results of the first tests provided valuable data on pressure suppression systems and measurements correspond essentially to preliminary calculations carried out in both Germany and Sweden. (UK)

20054 CLASSIFICATION OF PIPELINE SYSTEMS AND ITS APPLICATION IN THE CONSTRUCTION OF THE FIRST CZECHOSLOVAK NUCLEAR POWER PLANT. Kaisler, L. (Sigma, Olomouc, Czech.). Normalizace; 20: No. 12, 208-213(Dec 1972). (In Czech).

Categories of the A-1 power plant pipeline systems are defined as to their effect on the environment in case of an accident, and criteria of the classification are shown. A summary is given of the basic parameters of the A-1 power plant pipeline systems, as well as of both general and technical requirements for armatures used in the power station. The acceptance test procedures for the fittings and the methods for the weld quality inspection of the pipelines in the A-1 power plant are also surveyed. (INIS)

20055 CONTRIBUTION OF THE NUCLEAR FUELS INSTITUTE TO THE FUEL PROBLEMS OF THE A-1 NUCLEAR POWER PLANT. Kain, S.; Martinek, S.; Marek, J.; Vaclavik, E.; Hadacek, B.; Vesely, V. (Nuclear Fuels Inst., Zbraslav on the Vltav, Czech.). Jad. Energ.; 19: No. 9, 327-328(1973). (In Czech).

Within the framework of the multiple fuels testing program at the Nuclear Fuels Institute of the Uranium Industry Experimental Plant, preirradiation evaluation of fuel elements and other work touching on the problems of the A-1 nuclear fuel were carried out. An important problem solved in connection with a large-scale experiment was the preparation of fuel elements on a TR-O critical assembly. (tr-auth)

20056 RADIATION AND NUCLEAR SAFETY OF THE A-1 POWER PLANT DURING POWER COMMISSIONING. Kmosena, J. (Bohunice Nuclear Power Station, Czech.). Jad. Energ.; 19: No. 9, 319-320(1973). (In Czech).

The basic principles for ensuring nuclear safety of the A-1 nuclear power station during commissioning are discussed. Measurements and the results of safety evaluations are presented. It was established that the equipment and the way it was used guarantee safe conditions for personnel and the station environment. (tr-auth)

20057 DESIGN WORK FOR NUCLEAR POWER PLANT A-1 DURING CONSTRUCTION. Sklenicka, C. (Energy Project Engineer, Prague). Jad. Energ.; 19: No. 9, 303-307(1973). (In Czech).

The design work done during construction of the A-1 nuclear power station, which was started in the USSR in 1956, is summarized. After technical adjustments were made in 1960 at the Leningrad Thermal Power Station in the presence of Czechoslovakian project engineers, plant specialists and institute research workers, the design work was turned over to the Czechslovakian government. After additional adjustments in the design in Czechoslovakia, and new designs, coordination and supervision were arranged. This program ensured maintaining the concepts agreed upon by international experts in 1960. Only when multiple tests were made did the need for revising the system to increase the safety appear. (tr-auth)

20058 COOPERATION OF THE NUCLEAR RESEARCH INSTITUTE DURING CONSTRUCTION AND START-UP OF THE FIRST CZECHOSLOVAKIAN A-1 NUCLEAR POWER PLANT. Vorisek, M. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 9, 324-327(1973). (In Czech).

The most important research carried out at the Nuclear Research Institute in connection with construction and testing of the first Czechoslovakian A-1 nuclear power station is described. Attention is given to the physical tests on the KS-150 reactor and cooperation in studies on the radiation stability of the fuel elements. Information is included on other studies in the fields of physics, technology, and safety in connection with testing and use of the A-1 power station. (tr-auth)

20059 RESULTS OF REACTOR TESTS FOR THE FIRST CZECHOSLOVAK NUCLEAR POWER STATION. Komarek, A.; Nykles, O. Skoda Rev.; No. 4, 5-13(1973).

The test program for the Bohunice A-1 Reactor is described and the test results to date are summarized. (JWR)

20060 COOPERATION OF THE SKODA CONCERN IN PHYSICAL STARTING OF THE A-1 NUCLEAR POWER PLANT. Zbytovsky, A. Skoda Rev.; No. 4, 14-18(1973).

Activities associated with the startup of the Bohunice A-1 Reactor are summarized. The reactor physics parameters ob-

tained during the approach to initial criticality are presented. (JWR)

20061 STARTING OF A-1 NUCLEAR POWER PLANT. Cernik, P. Skoda Rev.; No. 4, 26-30(1973).

The extensive preparatory work preceding the startup of the Bohunice A-1 Reactor is described. The technical problems encountered during the reactor startup are discussed. (JWR)

20062 CHARGING MACHINE IN THE A-1 NUCLEAR POWER PLANT. Lavicka, J.; Korenek, J.; Hejman, J. Skoda Rev.; No. 4, 31-36(1973).

The fuel elements of the Bohunice A-1 reactor are replaced continuously during full power operation. The design of the charging machine for the refueling operation is described. The experience gained from charging machine testing is discussed. (JWR)

20063 COMMISSIONING PHYSICS EXPERIMENTS AT THE KS-150 REACTOR. Paulicka, J. (Bohunice Nuclear Power Station, Czech.); Zbytovsky, A.; Vorisek, M. Jad. Energ.; 19: No. 9, 291-297(1973). (In Czech).

Problems encountered in getting underway and installation of a non-Government system for physical start-up and physics experiments are discussed. Work and experiments on the KS-150 reactor of the First Czechoslovakian Nuclear Power Station A-1 and on reactor TR-0 for the A-1 are described. Possible hazards in the nuclear setup are considered, and data from the experiments are presented. (tr-auth)

Power Reactors, Breeding

Refer also to abstracts 18295, 18871, 18874, 20215, 20264, 20291, and 20503.

20064 (ANL-8017) DETERMINATION OF CARBON IN SODIUM BY TAB EQUILIBRATIONS AND BY CARBON METERS AND THE CARBURIZATION OF STAINLESS STEELS IN SODIUM SYSTEMS. Roche, M. F.; Allen, J. W.; Meyer, R. J.; Cafasso, F. A. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-31-109-eng-38. 45p. Dep. NTIS $4.00.

A method of determining carbon activity in sodium using Fe-12 wt % Mn tabs has been developed and tested over a range of carbon activities extending from 0.002 to 0.3 in 700°C sodium. The method was used to measure the carbon activity in sodium-filled, stainless steel loops and in the EBR-II reactor. The carbon activity at 700°C in EBR-II sodium was found to be 2.2×10^{-3}. In addition, the response of carbon meters and the carburization of stainless steels were studied using the tab method. Two carbon meters, a recently developed electrochemical meter and a pressure meter, were found to give measurements of carbon activity that were in good agreement with the values obtained using the Fe-12 wt % Mn tab method. Further development of these two meters for use as on-line monitors of carbon in sodium systems is recommended. It was found that the carburization of Type 304 stainless steel was dependent on sodium flow conditions, and, that the carburization varied as the square of the carbon activity (a_C^2) for fixed flow conditions. The a_C^2 dependence suggests that the major carbon species in sodium is disodium acetylide. Diffusion meters were found to give a response to carbon in sodium that parallels the carburization behavior of Type 304 stainless steel. Consequently, the diffusion meters are expected to be useful tools in steel carburization studies. (34 references) (auth)

20065 (ANL-8030) PERFORMANCE TESTING OF SELF-POWERED DETECTORS IN EBR-II INSTRUMENTED SUBASSEMBLIES XX01, XX03, AND XX04. Price, C. C.; Karvinen, J. R. (Argonne National Lab., Ill. (USA)). Nov 1973. Contract W-31-109-eng-38. 70p. AT.

Results from in-core irradiation tests of self-powered detectors in EBR-II are presented. The irradiated detectors contain emitter materials of cobalt, rhodium, and platinum, electrically isolated from an Inconel-600 collector by a crushed-ceramic insulator. Data are presented for transient and steady-state tests for detectors in an environment of 2.0×10^{15} n/cm²-sec fast flux, 1.7×10^9 R/hr at 950°F. In a fast reactor, the rhodium detector responds largely to neutron flux and the platinum and cobalt detectors respond to the gamma flux. Rhodium and platinum are more suitable emitter materials than cobalt for LMFBR applications, exhibiting sensitivities of 1.1×10^{-23} A/nv-in. and 2.5×10^{-17} A/(R/hr)-in., respectively. The cobalt detector responded essentially to reactor gamma flux, yielding a sensitivity of 5.1×10^{-19} A/(R/hr)-in., and generating an emitter current of negative polarity. 30 references. (auth)

20066 (ANL-8049) METHOD OF CHARACTERISTICS FOR ANALYSIS OF PRESSURE TRANSIENTS RESULTING FROM SODIUM-WATER REACTION IN HYDRAULIC NETWORKS. Shin, Y. W. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-31-109-eng-38. 44p. Dep. NTIS $4.00.

The governing partial differential equations for one-dimensional, unsteady flows are reduced to a set of ordinary differential equations by the method of characteristics. The governing equations include the complete Navier-Stokes equation in which the viscous term is written in terms of the Darcy-Weisbach friction factor. By appropriate matching of the boundary conditions at the pipe junctions, the flow conditions following the sodium-water reaction can be determined for the entire network. The resulting characteristic and compatibility equations are written in finite differences. A computer program was written to solve the finite-difference equations together with various junction conditions in which a stepwise numerical-integration technique was used. The program uses the sodium-water-reaction dynamics model as developed by Zaker and Salmon for characterizing the source pressure. The computer code was applied to calculate the pressure-pulse propagation in the EBR-II secondary sodium network for an assumed water leak rate of 1 lb_m/sec at one end of the superheater. The same problem also was solved by the linear inviscid-analysis method of the converted NAHAMMER code. The comparison of the two results for zero initial velocity showed good agreement, indicating that the nonlinear and viscous effects are negligibly small. Nevertheless, an increased difference was observed between the two results as the magnitude of the velocity was increased. (11 references) (auth)

20067 (ANL-CT-74-3) STUDY OF POTENTIAL CAVITATION IN LMFBR COMPONENTS. Arakeri, V. H.; Misra, B. (Argonne National Lab., Ill. (USA)). Jan 1974. 81p. AT.

A brief survey of the literature on cavitation inception and cavitation damage in hydraulic components such as pumps, flow control valves, inlet flow nozzles and orifices was carried out to determine whether cavitation initiating conditions exist under LMFBR plant operating conditions. Due to lack of significant experimental data in alkali liquid metal systems and the complex interaction of the various parameters that control cavitation inception, characterization of cavitation in liquid metals cannot be made based on data from aqueous systems without major uncertainties. Analyses of the cavitation characteristics of selected LMFBR components such as the primary pump, the butterfly valves of the SPTF and the inlet flow nozzle and orifice blocks for the fuel subassemblies were carried out using a selected set of existing theories and empirical correlations. The analytical results show that cavitation inception is not likely to occur at the design flow condition for the above mentioned components, except that cavitation may occur at the fourth butterfly valve of the SPTF. It should be noted that the selected theories and empirical correlations may not be the most up-to-date or the most widely used theories and correlations. 56 references. (auth)

20068 (ANL-CT-74-4) PRE-ANALYSIS OF INITIAL COMPACTION TESTS ON THE WARD CORE RESTRAINT TEST FACILITY USING THE SEMI-EMPIRICAL CODE PARABOW. Moran, T. J. (Argonne National Lab., Ill. (USA)). Jan 1974. 21p. AT.

A pretest analysis of initial compaction tests on the WARD Core Restraint Test Facility is made using the semi-empirical code PARABOW. The choice of parameters for PARABOW is based on the elastic effects of circumferential and radial deviatoric bowing using energy balance modeling techniques. Predictions of radial deflection of the outer row versus yoke load are made using these parameters as well as with arbitrarily chosen parameters representing additional effects including friction locking. Examples of individual duct loads are included. 4 references. (auth)

20069 (ANL-RDP-22) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, NOVEMBER 1973. (Argonne National Lab., Ill. (USA)). 8 Jan 1974. Contract W-31-109-Eng-38. 166p. AT.

Progress in LMFBR development studies is reported under the following headings: EBR-2; hot fuel examination facility; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and environmental studies. (DCC)

20070 (EURFNR-1114) ASB 71: DESCRIPTION OF THE TWO-DIMENSIONAL BURNUP AND MANAGEMENT PROGRAM FOR FAST REACTORS. Stein, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jun 1973. 111p. Dep. NTIS $7.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

ASB 71 is a two-dimensional burnup and management program

in R–Z geometry for fast reactors. With a few exceptions it is coded in IBM Fortran and designed for computers of the IBM 360 or IBM 370 series (e.g. IBM 360/65 or IBM 370/165). The program can, however, be used for slower computers, since a burnup calculation can be carried out in several smaller stages by means of the restart possibility incorporated in ASB 71. The program processes up to 26 energy groups, 99 mixtures and 10 fission products. It has a fixed isotope chain (^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu). The number of sites and areas is restricted only by the size of the available core store. Downward scatter into all energy groups and burnup of absorber material are permissible. The program contains a large number of management and evaluation possibilities which are described in greater detail in Annex 3. (10 references) (auth)

20071 (GULF-GA-A-12165) GAS-COOLED FAST BREEDER REACTOR. Progress Report, February 1, 1972–April 30, 1972. (Gulf General Atomic Co., San Diego, Calif. (USA)). 20 Jul 1972. Contract AT(04-3)-167. 151p. Dep. NTIS $9.75.

The tasks of the Gas-Cooled Fast Breeder Reactor (GCFR) program are program planning, core development, fuels and materials development, and nuclear analysis and reactor physics. The status of the development program planning document for the 300-MW(e) GCFR demonstration plant is given. Core development work included analyses of full-length roughening of the fuel-rod cladding, fuel-rod spacer support grid, radial blanket-element heat transfer and fluid flow, and fuel-rod performance. A reactor-temperature measuring instrumentation concept was analyzed and orifice control schemes were studied. Other studies under this task were of fast-neutron irradiation of the grid plate, core support structural seal analysis, a flow network analysis of the pressure-equalization system, and lower thermal shield design. The status of the thermal-flux and fast-flux irradiation programs is presented. Postirradiation examination and flow testing of the capsule GB-9 fuel rod is continuing. Assembly of the GB-10 fuel rod into its capsule hardware is 30% complete; design modifications were made to the fuel pellet stack to raise the temperature at the lower blanket-fuel interface. The fast-flux F-1 (X094) experiment was reconstituted into subassembly X094A for continuation of irradiation in the EBR-II. Gamma-scan data were taken during the interim examination of the seven-rod subassembly and capsule G-3 was removed for postirradiation examination. Available data from the gamma scans are presented. Reactor physics work included studies of control-rod worths in critical assemblies, sodium-voided experiments in plate geometry, sodium-voided pin zone experiments, and allowable uncertainties in the GCFR design. (auth)

20072 (IAEA-154, pp 63-78) GULF GENERAL ATOMIC GAS-COOLED FAST BREEDER REACTOR SYSTEM. Fortescue, P. 1973.

From proceedings of the IAEA study group meeting on the utilization of atomic energy; Minsk, USSR (24 Jul 1972).

The basically important features of helium as a medium for fast reactor cooling and their influence on reactor design are discussed. Helium can provide cooling adequate to achieve the highest useful fuel ratings; furthermore, with helium, the serious thermal-shock problems associated with the extreme heat-transfer properties of liquid metals are avoided. Other favorable features of helium that particularly influence safety, maintenance, and capital cost are also enumerated. Following a statement of ground rules and objectives, the design of a 300-MW(e) GCFR Demonstration Plant is summarized and then the principal features of this design that particularly characterize it, and the reasons for their being selected, are discussed. Tables listing the performance of the GCFR demonstration plant and that of a projected 1000-MW(e) prototype are included. On the comparative basis of operation only at hot-spot temperatures presently projected for LMFBR fuel (700°C), a fuel rating of 1 MW(t)/kg of fissile material is obtained as well as a conversion ratio of 1.45. It is concluded that even with no allowance for eventual higher temperature operation, a gas coolant can provide all the cooling a fast breeder reactor needs, and in so doing, it also uniquely provides a very high breeding gain. Furthermore, many practical engineering problems associated with liquid metal systems, particularly in the areas of safety and maintenance, are considerably eased with a gas-cooled system. (auth)

20073 (IAEA-154, pp 79-88) PAST AND FUTURE PROGRAMMES OF THE GBR ASSOCIATION. Chermanne, J. 1973.

From proceedings of the IAEA study group meeting on the utilization of atomic energy; Minsk, USSR (24 Jul 1972).

The program of the European Association for Gas Breeder Reactor (GBR Association) is described. As this program is complementary to other European effort going on, the background and environment are briefly dealt with. (auth)

20074 (IAEA-154, pp 127-134) INTERNATIONAL COOPERATION IN GAS-COOLED FAST REACTOR DEVELOPMENT WITHIN THE OECD NUCLEAR ENERGY AGENCY. Boxer, L. W. 1973.

From proceedings of the IAEA study group meeting on the utilization of atomic energy; Minsk, USSR (24 Jul 1972).

The short history of the international cooperation in gas cooled fast reactor development within the OECD Nuclear Energy Agency from 1967 to 1972 is given. (INIS)

20075 (IAEA-154, pp 135-166) DESIGN STUDY OF He GAS-COOLED FAST BREEDER REACTOR. Mochizuki, H.; Izaki, T.; Takitani, K.; Koikae, H.; Kobayashi, Y.; Matsuki, Y.; Ooka, T.; Tanaka, R.; Watanabe, T.; Kobayashi, T. (Kawasaki Heavy Industries Ltd., Tokyo). 1973.

From proceedings of the IAEA study group meeting on the utilization of atomic energy; Minsk, USSR (24 Jul 1972).

Work on the 1000 MW(e) size GCFBR started in 1967 is described. Since 1970, effort has been focussed on the He Gas-cooled fast breeder with pin type mixed oxide fuel and an indirect steam cycle. At present the work is on the primary system and on safety. Some studies on the He GCFBR are briefly described. As the designing parameters, fuel pin diameter, reactor core height, coolant flow area ratio, and blanket thickness were surveyed, fuel burn up characteristics were studied. Two-dimensional burn up calculations were executed including the two-batch refueling. After a wide range survey, the optimization was processed considering fissile Pu inventory, doubling time, and fuel cycle cost. The He GCFBR has promising features such as 2,500 kg of fissile inventory and about 9 years of doubling time. (auth)

20076 (ORNL-TM-4420) FAST REACTOR EXPERIMENTAL SHIELDING PROGRESS REPORT, AUGUST–SEPTEMBER 1973. 189a No. 10028, Activity No. HN 04 01 01 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N.; Freestone, R. M. Jr. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 79p. AT.

The work performed by the ORNL Neutron Physics Division in Fast Reactor Experimental Shielding Research during August and September, 1973 is described. The Fast Test Reactor (FTR) and Demonstration Plant Reactor (Demo) first-fission experiments were completed, which provided data on the fission rate of ^{239}Pu and ^{235}U as a function of shield thickness. Shield mock-ups for both the FTR and Demo plant reactors were constructed, and plutonium and uranium fission counters were utilized to obtain absolute fission rates behind the shields. Experimental results were in disagreement with the results from a preliminary analysis of the experiment. Results were obtained on the effectiveness of a graphite reflector in increasing the counting rate for ex-vessel detectors in both the FTR and Demo configurations. Increases in count rates by factors of ~8.0 resulted in both cases. Also reported are experiments which were intended to evaluate the accuracy of thermoluminescent dosimeters (TLDs). TLD results are compared with calculated results for a ^{60}Co source shielded by iron. Calculations are also compared with spectral measurements using a sodium iodide spectrometer. Two-parameter hydrogen counter data for the Inconel experiment completed in July are also presented, which completes the reporting of the data from Inconel experiments. (auth)

20077 (GEAP-13825-7) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE. Seventh Quarterly Report, July–September 1973. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Oct 1973. Contract AT(04-3)-893. 40p. AT.

The development of instrumentation for surveillance of the core and in-vessel components of liquid metal fast breeder reactors is reviewed. Current efforts are on high temperature neutron detectors and reactivity monitoring systems. (auth)

20078 (RT/ING-(73)14) SOME NEUTRONIC PROBLEMS IN THE PEC REACTOR. Dominici, G.; Tavoni, R.; Sena, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 Aug 1973. 27p. (CONF-731015-4). Dep. NTIS (U. S. Sales Only) $3.50.

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973).

The neutronic characteristics of the PEC reactor are outlined. The PEC reference core is UO_2–PuO_2 fueled and a comparison with a UO_2 previous core is made. The burnup evaluations have been referred to two different cycle schemes reaching different flattening in the discharge burnup; two enrichments for the fresh fuel have been taken into account. The reactor characteristics under a set of test zone alternatives have been considered. The

insertion of the scram rods has been calculated in three dimensional geometry. (9 references) (auth)

20079 (RT/ING-(73)15) TWO-PHASE FLOW REGIMES FOLLOWING POWER TRANSIENTS. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1972. 21p. (CONF-721154-2; PRV-RVI-PEC-719). Dep. NTIS (U. S. Sales Only) $3.25.

From meeting on liquid metal boiling working group; Karlsruhe, F. R. Germany (6 Nov 1972).

The text of the lecture of the Liquid Metal Boiling Working Group of the CREST (Committee on Reactor Safety Technology) held in Karlsruhe, 6-7 November 1972 is presented. The different two-phase flow regimes observed during forced convection sodium boiling experiments are analyzed, and a first attempt to map different boiling patterns is described. 5 references. (auth)

20080 (TID-3334-81) SODIUM TECHNOLOGY, 1972-1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 186p. Dep. NTIS $7.60.

References to 897 publications on sodium and NaK technology cited in Nuclear Science Abstracts Volume 26 (1972) through Volume 27 (1973 through June) are contained in this bibliography. Keyword indexing is displayed under each citation to provide information on the contents of the document. References are arranged in order by the original NSA abstract number which approximately places them in chronological order. Sequence numbers appear beside each reference, and the personal author index refers to these sequence numbers. The subject index refers to the original abstract numbers. (auth)

20081 (WARD-OX-3045-6) 11:1 SCALE ROD BUNDLE FLOW TESTS, PARTS 1 THROUGH 7. Pechersky, M. J.; Roidt, R. M.; Vegtr, B. J.; Markley, R. A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Feb 1974. Contract AT(11-1)-3045. 268p. AT.

Information on the scale rod bundle flow tests is presented concerning the pre-test predictions, bare rod flow distribution studies, hydraulic analysis of bare rod test, intersubchannel mixing studies, grid loss coefficients, grid-type rod bundle flow distribution, and grid-type rod bundle mixing studies. (DCC)

20082 COOPERATIVE GAMES FOR $^{238}U-^{239}Pu$ FAST BREEDER REACTOR OPTIMIZATION. Pavelescu, M.; Dumitrescu, H.; Purica, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 7, 849-858(1973).

The fast breeder reactor optimization usually implies the maximization or minimization of a certain parameter. This optimization is not quite convincing because none of the possible parameters describes completely the reactor. Biparametric optimization superior to the monoparametric one is shown to have a bimatrix game structure. The solution of the cooperative game is shown to be better than the solution of the competitive game. Afterwards, some games concerning fast breeder reactor optimization are solved and commented. (7 references) (auth)

20083 EXPANDED BED NUCLEAR REACTOR FUEL MODULE. Chamberlain, H. V.; Edwards, J. J.; Kovacic, E. C. (to United States Atomic Energy Commission). Danish Patent 127,396. 29 Oct 1973. Filed date 24 May 1968. 9p. (In Danish).

A fuel module is described for a fast breeder reactor which is a shell and tube heat exchanger with a liquid metal coolant on the tube side and an expanded bed of fuel particles in liquid metal on the shell side. Baffles are provided to prevent rapid collapse of the expanded bed and to establish an axial temperature gradient in the bed and an eductor is employed for discharge of the bed from the module. (auth)

20084 RESULTS OF THE OPTIMIZATION OF THE INVESTIGATION OF FAST REACTORS WITH 1000 MW(e), COOLED WITH NITROGEN TETRAOXIDE. Krasin, A. K.; Nesterenko, V. B.; Naumov, V. A.; Bubnov, V. P.; Mirgorodsii, V. S.; Sal'nikov, L. I.; Slizov, V. P.; Stavrov, A. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 5-12(1973). (In Russian).

The results of the optimization researches of the reactor block of APS with the fast reactor cooled with the dissociating nitrogen tetraoxide are cited. Fast reactors representing single blocks with electric capacity of 1 million kW are considered. Matrix fuel consisting of uranium and plutonium dioxide particles with chromonickel cladding to avoid chemical reaction with N_2O_4 is used as fuel composition. The percentage of metal in matrix was supposed to be 30% in volume. Doubling time fuel constituents of calculated expenditures were selected as optimum parameters. (23 references) (auth)

20085 DESIGN AND IMPLEMENTATION OF THE PROTOTYPE FAST REACTOR SIMULATOR. Arthorne, G. Nucl. Eng. Int.; 18: No. 211, 952-956(Dec 1973).

A description is given of the PFR simulator at Dounreay, which is to provide training facilities for supervisors and operators and to form part of the Reactor Training School courses. The simulator computer is a Redifon R 2000 24 bit central processor with a cycle time of 1 μs. A hardware feedwater controller is used. On-line programmes are outlined and the overall performance and degree of simulation are discussed. (UK)

20086 6000 HOURS TESTING OF A FULL-SCALE PROTOTYPE SODIUM PUMP. Fakkel, R. H.; Heslenfeld, M. W.; Vroom, J. P. (Veratoom NV, The Hague). Nucl. Eng. Int.; 18: No. 211, 949-951(Dec 1973).

A full-scale prototype of the primary sodium pumps to be used in the hot legs of the SNR 300 loop-type fast breeder reactor is described. It has completed 6000 hours of rigorous testing under normal operating conditions and abnormal conditions such as thermal shock, low speed and manual start up. The encouraging results which are described are considered to be representative of the three production primary pumps for SNR 300 and acceptance tests in water will suffice for these units. (auth)

20087 GCFR SAFETY. Chermanne, J. pp 257-265 of Gas-Cooled Fast Reactors. Vienna; International Atomic Energy Agency (1973).

From proceedings of the IAEA study group meeting sponsored by the USSR State Committee on the Utilization of Atomic Energy; Minsk, USSR (24 Jul 1972).

The safety aspects of GCFR techniques are closely related to those of present other gas-cooled reactors such as AGR and HTR. The higher coolant pressure needed brings more severe conditions regarding depressurization. Some part of the LMFBR safety can also be used. (auth)

20088 DESCRIPTION OF GBR REFERENCE DESIGNS. Chermanne, J. pp 167-190 of Gas-Cooled Fast Reactors. Vienna; International Atomic Energy Agency (1973).

From proceedings of the IAEA study group meeting sponsored by the USSR State Committee on the Utilization of Atomic Energy; Minsk, USSR (24 Jul 1972).

The description of the different GBR reference plant designs is made with comparison between the pin and coated particle types of reactors. (auth)

20089 GCFR FUEL ASSEMBLIES. Chermanne, J. pp 367-380 of Gas-Cooled Fast Reactors. Vienna; International Atomic Energy Agency (1973). (In Russian).

From proceedings of the IAEA study group meeting sponsored by the USSR State Committee on the Utilization of Atomic Energy; Minsk, USSR (24 Jul 1972).

Fuel assemblies for GCFRs proposed by the GBRA are described. One assembly uses vented pins clad in stainless steel and cooled by helium. This assembly is similar to that of an LMFBR but the clad temperature is slightly higher, the pin internal and external pressures are equalized and the clad is provided with external roughening to improve heat transfer. The other assemblies use beds of coated fuel particles directly cooled either by helium or by carbon dioxide; they allow gas temperatures similar to those of HTR or AGR but with relatively low coated particle temperatures. (auth)

20090 GAS-BREEDER MEMORANDUM AND THE RESEARCH AND DEVELOPMENT PROGRAM OF THE FEDERAL REPUBLIC OF GERMANY IN THE FIELD OF GAS-COOLED FAST REACTORS. Dalle Donne, M. (Kernforschungszentrum, Karlsruhe, Ger.). pp 267-288 of Gas-Cooled Fast Reactors. Vienna; International Atomic Energy Agency (1973). (In Russian).

From proceedings of the IAEA study group meeting sponsored by the USSR State Committee on the Utilization of Atomic Energy; Minsk, USSR (24 Jul 1972).

The gas-breeder memorandum describes technical aspects of international evaluations of gas- and steam-cooled fast reactors. Present activities and research and development prgrammes in the field of GCFR's at the nuclear centers of Karlsruhe and Jülich and also of Siemens are considered. (INIS)

20091 METHOD OF OPERATION OF A NUCLEAR REACTOR PLANT WITH A FAST BREEDER REACTOR AND A FUEL REPROCESSING PLANT. Haefele, W.; Vogg, H. (to Kernforschungszentrum). German Patent 1,489,919. 29 Mar 1973. 2p. (In German).

The process assumes that only fuel-free breeding materials are fed into the reactor core after it reaches stationary operation conditions. The residence time of the breeder elements in the reactor core is manyfold the time of the fuel elements, and when the fuel element is changed, only a fraction of the whole fuel elements are exchanged. The process is thus characterized in that the fuel and breeder elements are simultaneously taken out of the reactor core

in a ratio which is determined by their optimum residence time. These fuel and breeder elements are reprocessed together. (GE)

20092 OPTIMAL NUCLEAR FUEL MANAGEMENT MODEL FOR FAST REACTORS. Stoll, H. G.; Axford, R. A. (Univ. of Illinois, Urbana). Nucl. Technol.; 21: No. 2, 85-98(Feb 1974).

A utility system operational planning model of a Liquid Metal Fast Breeder Reactor is developed together with an in-core optimization algorithm to minimize the fuel cost of each cycle. The optimization algorithm determines the batch size and position of two refueling enrichments, the shuffling of partially irradiated fuel, and the fuel to be discharged such that the utility system energy and reactor plant maintenance requirements are met. The in-core model includes a description of the fuel depletion and discrete fuel assembly configuration. 26 references. (auth)

20093 METHOD FOR DETECTING FUEL CLADDING PENETRATION IN LMFBRs BY MONITORING THE SODIUM COOLANT FOR IODINE-135. Chellew, N. R.; Miller, W. E.; Kessie, R. W.; McPheeters, C. C.; Nelson, P. A. (Argonne National Lab., IL). Nucl. Technol.; 21: No. 2, 125-132(Feb 1974).

Work has been completed to demonstrate the feasibility of a new cladding-failure monitoring technique based on determination of the ^{135}I content of the primary sodium coolant of Liquid Metal Fast Breeder Reactors (LMFBRs). The method was devised to aid in detecting the penetration of fuel element cladding by sodium coolant. The method consists of isolating a small volume of primary sodium, sparging it with an inert gas to strip out dissolved gases which are discarded, further sparging the sample to strip ^{135m}Xe produced by ^{135}I decay, and calculating the ^{135}I content of the sodium from the ^{135m}Xe content of the second sparge. A sparging monitor was built and tested to determine the time required to sparge dissolved radioxenon (^{133}Xe) from molten sodium. This time varied from ~1 to 1.5 min, depending on experimental conditions. For the calculated background level of ^{135}I in the primary sodium of Experimental Breeder Reactor II, a counting time of ~2 min would be required to determine the amount of ^{135m}Xe removed by the second sparging to a 1σ counting precision of ±4%. A shorter counting time would be required for higher ^{135m}Xe levels that would occur during fuel failure. A system with automatic controls was designed for monitoring ^{135}I in the primary sodium of an LMFBR. (auth)

20094 DEVICE FOR SCRAPING OFF SODIUM FROM A CYLINDRICAL ROD. Bernavon, J.; Michot, G. (to Commissariat a l'Energie Atomique). French Patent 2,135,697. 2 Apr 1971. 6p. (In French).

A device is presented for removing the sodium deposit from cylindrical rods moving in this metal. The device is intended, in particular, for the arm used to manipulate fast neutron reactor fuel elements. A cylindrical ring encloses the moving rod, the base of which is slightly truncated. The lower end of this rod forms a knife edge which presses against the surface of the rod. For this purpose, the ring is provided along most of its length with slits parallel to the axis of the scraper. (FR)

20095 PHYSICS AND ENGINEERING OF PLANTS WITH LARGE GAS-COOLED FAST BREEDER REACTORS. Ponomarev-Stepnoi, N. N.; Glushkov, E. S.; Grebennik, V. N.; Demin, V. E.; Khrulev, A. A. pp 191-234 of Gas-Cooled Fast Reactors. Vienna; International Atomic Energy Agency (1973). (In Russian)

From proceedings of the IAEA study group meeting sponsored by the USSR State Committee on the Utilization of Atomic Energy; Minsk, USSR (24 Jul 1972).

Fast physical systems which can serve as the basis for the creation of breeder reactors with a duplication time of 3 to 5 years are examined. Among them are reactors with small Pu-active zones with hard neutron spectra, high value of the breeding ratio (BR = 2), and large volume power intensity (2 to 3 mvt/yr); reactors with multiplutonium-active zone; and reactors with dilute active zone. Modular, non-integral, and integral circuits of atomic power plants can be taken as engineering embodiments of these systems. (tr-auth)

20096 FAST NEUTRON REACTOR. Grischanin, E. I.; Murogow, W. M.; Orlow, W. W.; Totschenij, L. W. German Patent 2,141,008. 22 Feb 1973. 13p. (In German).

In this reactor, a breeder blanket surrounds a reactor core made up of an inner and outer concentrically arranged zone. The nuclear fuels used are for the outer core section ^{239}Pu (as PuO_2-UO_2 oxide) and for the inner core section ^{235}U (as metal). (GE)

20097 RADIOACTIVITY IN THE PRIMARY SYSTEM OF SODIUM-COOLED FAST REACTORS. Ullmann, H.; Kuenstler, K.; Richter, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 4, 96-105(Apr 1973). (In German).

Sodium-cooled fast reactors are operated under conditions of highly radioactive primary coolant systems. In the last 10 years experience has been gained with the operation of highly radioactive sodium coolant loops in experimental fast and thermal reactors. In addition to unavoidable activation of the coolant, radioactive contamination by fission products and corrosion products was observed. Economical effects on maintenance and repair works may arise particularly from the long-lived nuclides. The problem of radioactive contamination of the primary coolant loop becomes important by the high burnup, elevated sodium temperatures, and planned application of vented fuel elements intended for the concepts of large fast reactors. This trend in further development of fast reactors at present is confronted with the insufficient possibilities of decreasing radioactive contamination. The experience gathered with the experimental reactors proves applicable to larger reactors but qualitatively. It has been obtained as a secondary result during operation or in failure studies. Therefore, the theoretical and experimental fundamentals have been thoroughly investigated recently in order to find starting points for practical solutions with respect to large reactors. (auth)

20098 REFUELING STUDIES IN RADIAL BLANKET OF LARGE FAST BREEDER REACTOR. Otake, I. (Fuji Electric Co. Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 10: No. 10, 598-606(Oct 1973).

Refueling schemes in the radial blanket of the large fast breeder reactor are discussed. The reactor adopted for these studies is a 1,000 MW(e) sodium cooled, mixed plutonium-uranium oxide fuel unit with a thermal rating of 2,400 MW. Burnup calculations, combined with different refueling schemes are carried out to determine its characteristics. From the results obtained on power distribution, the coolant flow rates in the core and in the different blanket layers are calculated under the condition of limited cladding temperature. The different refueling schemes are then compared mainly from the standpoint of the thermal performance of the reactor. (auth)

20099 FAST-BREEDER REACTOR: WHEN, WHERE, WHY, AND HOW. Friedlander, G. D. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 11: No. 2, 85-89(Feb 1974).

The basic design characteristics of a LMFBR are presented. The planned LMFBR development program in the U. S. is described. (DCC)

20100 HEAT TRANSFER SYSTEM. Schins, H. E. J.; Peter, F. G. (to Commission of the European Communities). Luxembourg Patent 64,733. 9 Feb 1972. (In German).

A heat transfer system located between a primary and a secondary liquid coolant loop is based on the evaporation cooling principle. The tubes of the primary and secondary coolant loop are mounted coaxially within the heat exchange zone reserving a free interspace between them. Lodged within this interspace is a capillary porous insert which is impregnated with an evaporation liquid and presents vapor spaces acting in a direction vertical to the insert's axis. The spaces are disposed over the length of the insert. The heat exchange system is of special interest for Na-K-cooled nuclear reactors. (EU)

20101 CRACKING IN WELDED JOINTS. Occurrence and Prevention in Nuclear Plant. II. Dickinson, F. S.; Weld, F.; Watkins, I.; Watkins, B. Weld. Metal. Fabr.; 41: No. 10, 346-352 (Oct 1973).

Weld cracking in heat exchangers for handling liquid sodium is discussed. The behavior of AISI 321 stainless steel for tube to tube plate welds is compared with stabilized 2¼ Cr 1% Mo steel in welds of similar geometry. Inspection of these welds using both ultrasonic and radiographic techniques is briefly described. Other applications of stabilized steels in sodium circuits are considered. The problem of laminar tearing at joints and methods adopted to combat it are also discussed. (UK)

Research, Test, and Experimental Reactors

Refer also to abstracts 18251, 18429, 18536, 20063, 20064, 20066, 20069, 20076, 20213, 20220, 20342, and 20343.

20102 (ANL/EBR-79) CORE-LOADING DIAGRAMS FOR EBR-II RUNS 51-67 (AUGUST 1971-DECEMBER 1973). EBR-II Project. Case, J. C. (comp.). (Argonne National Lab., Idaho Falls, Idaho (USA)). Jan 1974. Contract W-31-109-eng-38. 59p. Dep. NTIS $5.00.

The core-loading diagrams for EBR-II runs 51 through 67, which were made in EBR-II between August 1971 and December 1973 are presented. During those runs, the reactor accumulated 25,679 MWd of operation. (The reactor had been operated for an additional 46,863 MWd in runs 1-50, made between August 1964 and August 1971.) The loading diagrams appear in numerical, and thus chronological, order. Locations of experiments are highlighted in each diagram through the use of a black background behind the identifying numbers of the experiments. The center of the core is identified in each diagram by a circle, and the core sectors are identified by the letters A through F around the perimeter of the core diagram. A table at the end of the report summarizes the pertinent information for every EBR-II run through run 67. (auth)

20103 (IDO-17005) ADVANCED REACTIVITY MEASUREMENT FACILITIES. A Description and Performance Evaluation. Burdick, E. E.; Fast, E.; Knight, D. W. (Phillips Petroleum Co., Idaho Falls, Idaho (USA). Atomic Energy Div.). Oct 1964. Contract AT(10-1)-205. 70p. Dep. NTIS $5.50.

The Advanced Reactivity Measurement Facilities, ARMF-I and ARMF-II, are nearly identical critical facilities and are used almost exclusively for measuring reactor physics parameters, such as reactor-spectrum cross sections and resonance integral cross sections. They are, therefore, designed to (a) have large statistical weights for fuels and poisons, (b) be mechanically stable enough to produce reproducible reactivity measurements, and (c) have sensitive instrumentation capable of measuring very small reactivities. These facilities are swimming-pool-type reactors having light-water moderated cores made up of plate-type fuel elements containing fully enriched U-235. The facilities are located at the National Reactor Testing Station in Idaho near the Materials Testing Reactor (MTR). Being located near the MTR permits measurements on short-lived fission products and transmuted isotopes. By use of the capsule transfer tube connecting the MTR and ARMF canals, a capsule can be transferred from the MTR hydraulic rabbit to the ARMF and prepared for reactivity measurements in 15 minutes. Both ARMF reactors use a servo-controlled regulating rod for reactivity measurements rather than a pile oscillator. The reactivity effect of a capsule placed in the reactor is determined from the resultant regulating rod displacement. In order to make the regulating rod a precise measuring device, its drive and position instrumentation includes no gears. Because the rod rotates about a vertical axis, it can be driven by a torque motor, the armature of which is attached directly to the rod. A digital shaft-angle encoder, the position transducer, also attaches directly to the rod. Characteristics important to facilities used for reactivity measurements are statistical weights and expected measurement errors. Typical statistical weights in the ARMF are (a) 2.8×10^{-2} $\Delta k/k$ per g of natural boron, (b) 6.36×10^{-4} $\Delta k/k$ per g of U-235, and (c) 1.16×10^{-4} $\Delta k/k$ per g of gold inside a cadmium shield. Expected measurement error (standard deviation) for a single 4.5 minute capsule measurement is 10^{-1} $\Delta k/k$. (13 references) (auth)

20104 (JAERI-M-5295) EXPERIMENTAL ANALYSIS OF JRR-4 REACTOR NOISES ON VARIOUS REACTOR POWER AND COOLANT FLOW RATE. Oka, Y.; An, S.; Tomii, K. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 25p. (In Japanese). NTIS (U. S. Sales Only).

Reactor noise analysis was conducted on JRR-4 at various operational conditions. The dependence of fluctuation levels on flow rate and reactor power reveals that the noise source of JRR-4 is the vibration of the shim control rods. Simultaneous measurements with two compensated ionization chambers clarify that there is no spatial difference in neutron density fluctuation below 3 Hz. The power spectral densities at various operational conditions are also presented. (auth)

20105 (JEN-270) COUNT-TO-COUNT TIME INTERVAL DISTRIBUTION ANALYSIS IN A FAST REACTOR. Perez-Navarro Gomez, A. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 134p. (In Spanish). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis. Submitted to Univ. of Madrid.

The most important kinetic parameters have been measured at the zero power fast reactor CORAL-1 by means of the reactor noise analysis in the time domain using measurements of the count-to-count time intervals. 69 references. (auth)

20106 (KFK-1846) CAMAC-SCALER-TIMER-SYSTEM WITH COMPUTER CONTROLLED DATA EVALUATION. Borcherding, K.; Kaufman, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Labor fuer Elektronik und Messtechnik). Sep 1973. 51p. (In Germany). Dep. NTIS (U. S. Sales Only) $4.75.

CAMAC standardized modules, a real time clock, a binary-to-BCD-converter, a timer and four scalers are assembled to a scaler-timer-system and coupled to the PDP 8/E-computer by a Single Crate Controller SCC-8/E. This system is a part of a measuring plant surveying the pins of the compact sodium cooled reactor KNK. An extensive computer program sifts the pulse rate values and selects only those data for print whose values are not in accordance with variable preset conditions of tolerance. Together with a preselectable gate time for scaling, the evaluation of the easy readable cycle record simplifies very much the process control and replaces the practice of analog drawing of the data used in the past. The report discusses in detail the data selection process and points out how to evaluate the record and how to dimension the control parameters of the cycle. (GE)

20107 (KFK-1878) ADJUSTMENT OF GROUP CROSS SECTIONS FOR FAST REACTOR CALCULATIONS USING INTEGRAL DATA FROM CRITICAL ASSEMBLIES. Fischer, E. A. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Oct 1973. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

A series of integral measurements on fast critical assemblies was used to adjust group cross sections by a least-squares procedure. The initial cross sections were those of the well-documented Karlsruhe group constant set NAPPMB. The integral data were calculated by the same methods which are used in the routine analysis of critical experiments. Then, adjustments to these cross sections were obtained by a least-squares procedure, which minimizes the errors on the integral data, plus the errors on the cross sections. The procedure was carried out for two cases, using foil measurements, and fission chamber measurements of the fission ratio F8/F5. The results are discussed, and used to judge the consistency of integral measurements. 29 references. (auth)

20108 (ORNL-4880) FINAL REPORT ON A BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT IN THICK SODIUM. Maerker, R. E.; Muckenthaler, F. J.; Childs, R. L.; Gritzner, M. L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 107p. Dep. NTIS $5.45.

An experiment concerning deep neutron penetration in sodium is described, and experimental results are presented which provide a basis for verification of the accuracy of sodium cross sections to be used in transport calculations. The experiment was performed at the Tower Shielding Facility of ORNL and included measurements of both the neutron fluence and neutron spectra through a large diameter sample of sodium up to 15 ft thick. Calculated results for the experiment are presented for comparison with the experimental measurements. These results were obtained using the multigroup Monte Carlo code, MORSE, and a two-dimensional discrete ordinates code, DOT III. One-hundred group data sets were developed from both a preliminary and the final version of the ENDF/III set (MAT = 1156) for sodium for use in the calculations. Comparisons of the calculations with experiment indicate that the preliminary version is slightly superior to the final version and that using the preliminary set the total neutron leakage above thermal energies penetrating up through 15 ft of sodium can be calculated to within ~15% and the absolute spectra penetrating up through 12.5 ft of sodium can be calculated to within 20%. Using the final set, the corresponding comparisons are 30% and 60%. (20 references) (auth)

20109 (ORNL-TM-4453) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, JULY, AUGUST, AND SEPTEMBER OF 1973. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 54p. Dep. NTIS $4.75.

The ORR operated at an average power level of 29.8 MW for 79.1% of the time during July, August, and September of 1973. Twenty-three fuel elements were declared spent (47.5% average burnup) during the quarter, while twenty-three new elements were placed in service. Two shim-rod elements were retired from service at an average burnup of 90%. The reactor was shut down on ten occasions, all of which were scheduled. The end-of-cycle No. 113 shutdown accounted for 85.9% of the total downtime, with the remainder used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. The end-of-cycle No. 113 shutdown was extended ~12 days to make repairs on the reactor primary water line at the reactor primary pump house. Special tests or measurements completed during the quarter included: (1) core flux mapping, (2) shim-rod calibrations, (3) OF-1 (CP-E3) reactivity check, and (4) special test for proposed experiments. (auth)

20110 (ORNL-TM-4450) CALCULATION OF ENERGY DEPOSITIONS AND DOSE RATES IN PROPOSED SHIELDING SURROUNDING THE TSR-II REACTOR. Uchida, S.; Lewin, J.; Maerker, R. E. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

The spherical distributions of dose rates and energy depositions due to neutrons and gamma rays in several kinds of shields surrounding the TSR-II reactor are presented. The distributions were calculated using ANISN. These results are used to determine an adequate configuration for the proposed new shielding around the TSR-II when a 3-ft-diameter collimator is employed. (auth)

20111 (PTB-FMRB-47) POWER AND BURNUP AT THE RESEARCH AND MEASUREMENT REACTOR BRAUNSCHWEIG (FMRB) OF THE PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT. Debertin, K.; Hollnagel, R.; Knauf, K.; Roethemeyer, H.; Urbach, G.; Viehl, E.; Wittstock, J. (Physikalisch-Technische Bundesanstalt, Brunswick (F. R. Germany). Forschungs- und Messreaktor). Aug 1973. 29p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

The "Research and Measuring Reactor Braunschweig" (FMRB) of the Physikalisch-Technische Bundesanstalt is operated by two MTR-cores weakly coupled by a heavy water tank. The total thermal power of the reactor (power of the north and south core) is determined by the temperature-increase of the coolant and supervised by means of a ^{16}N-decay monitoring system. The powers of the single cores are derived from an integration of the local neutron flux density distribution measured by means of activation probes at every new core configuration. When the total power is known, however, the power ratio is all that is needed. This ratio results from period-reactivity-measurements. For reactor operation purposes the burnup is derived from the energy released in every fuel element. For some elements the results of this method are compared with burnup determinations by means of reactivity-measurements and gamma-ray-spectroscopy. (16 references) (auth)

20112 (PTB-FMRB-49) EXPERIENCE IN THE OPERATION AND RADIATION PROTECTION OF THE RESEARCH AND MEASUREMENT REACTOR BRAUNSCHWEIG FOR THE YEAR 1972. Heintz, W.; Siegel, V. (Physikalisch-Technische Bundesanstalt, Brunswick (F. R. Germany). Forschungs- und Messreaktor). Sep 1973. 27p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

20113 (RT/FI-(73)17) CAVMA3: AN IBM 360/75 CODE FOR CALCULATING AXIAL AND RADIAL COMPONENTS OF THE MAGNETIC FIELD GENERATED BY A FINITE-DIMENSIONS AXIALLY SYMMETRICAL COIL. Application to the Experiment of Magnetic Scattering in Nuclear Reactor. Franco, F.; Pedretti, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 15 May 1973. 127p. Dep. NTIS (U. S. Sales Only) $8.50.

CAVMA3, written in FORTRAN IV, calculates axial and radial components of the magnetic field generated by a coil characterized by axial symmetry and decomposable into finite-dimensions solenoids. Particular care has been devoted to calculation accuracy near the boundary-surfaces of the solenoid for obtaining consistency of calculated values through any boundary-surface and for avoiding distortions in the magnetic field lines to be calculated by the LIMA code which incorporates CAVMA3 as a fundamental block. Results of sample calculations are reported. 12 references. (auth)

20114 END LOCKING DEVICE FOR NUCLEAR CANNING TUBES TO BE USED IN EXPERIMENTAL NUCLEAR REACTORS. Klein, K.; Munsch, F.; Morini, R. (to Commission of the European Communities). LU 64,993. 20 Mar 1972. (In German).

The invention relates to an end locking device for nuclear canning tubes to be used in experimental nuclear reactors. The device comprises a plug and a pressure plate, the latter co-operates with a twisted X-ring seal. (EU)

20115 DOSIMETRICAL ANALYSIS OF REACTOR LEAKAGE GAMMA-RAYS BY MEANS OF SCINTILLATION SPECTROMETRY. Jun, J. S. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 4, 291-309(Dec 1973).

Exposure rates due to leakage gamma-rays from operating reactors TRIGA Mark II and III were measured in a horizontal plane by means of scintillation spectrometry using a 3" × 3" cylindrical NaI(Tl) detector associated with a 400 channel pulse height analyzer under varied conditions of reactor operation. In determining exposure rate due to the leakage gamma-rays at each point of measurement, Moriuchi's spectrum-exposure rate conversion theory was applied instead of using conventional response matrix method which necessitates very complicated procedures to convert a spectrum into exposure rate. The results show that a basic pattern of "typical" spectrum of the reactor leakage gamma-rays is neither affected by thermal output of the reactor, nor influenced by overall attenuation in radiation intensity. It was indicated that the attenuation of the leakage gamma-rays in air in terms of exposure rate as a whole follows an exponential law, and the total exposure rate due to the leakage gamma-rays at a certain point is nearly proportional to thermal output of the reactor. The complexity in spectrum measured for a movable core reactor, TRIGA Mark III, was analyzed through spectrum resolution, and proper judgement of the leakage gamma-rays in a complex spectrum was discussed. (31 references) (auth)

20116 MEASUREMENT OF THE FAST NEUTRON FLUX DENSITY IN THE BULK SHIELDING EXPERIMENTAL TANK OF THE TRIGA MARK-II REACTOR USING SOLID STATE TRACK DETECTOR. Ro, S. G.; Jun, J. S.; Cho, S. H. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 4, 334-338(Dec 1973).

The horizontal distribution of the fast neutron flux density in the Bulk Shielding Experimental Tank of the TRIGA Mark-II reactor at the steady power of 250 kW has been measured using a solid state track detector which is natural mica placed in contact with ^{232}Th fissile foil. The neutron flux density was calculated on the assumption that the fast neutron spectrum is similar to that from the thermal-induced ^{235}U fission. The resulting flux density distribution along the horizontal line from the center of the thermalizing column door is presented in tabular and graphical forms. (9 references) (auth)

20117 PRESSURIZED WATER TEST LOOP AT THE FR2 RESEARCH REACTOR. Lederer, B.; Harbauer, G.; Karb, E.; Schmidt, T. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 15: No. 11, 514-520(Nov 1973). (In German and English).

A pressurized water test loop was built at the FR2 research reactor of the Nuclear Research Centre at Karlsruhe. The loop is for the forced convection cooling of irradiation specimens with high heat flux densities, especially for fuel specimens. The loop was built originally for the irradiation of MTR-type fuel plates, but it can also be used for irradiating specimens of other types provided they meet certain geometric and thermodynamic limiting conditions. The basic conception and the design of the loop, the design of the rigs used for the irradiation of fuel plates, some safety aspects and, finally, the experience accumulated during the test phase and during 2.5 years of in-pile operation are discussed. (GE)

20118 CORRELATION BETWEEN NEUTRON NOISE AND FUEL ELEMENT OSCILLATIONS IN THE ECO REACTOR. Lucia, A.; Ohlmer, E.; Schwalm, D. (Commission of the European Communities, Ispra, Italy). Atomkernenergie; 22: No. 1, 6-8(Sep 1973).

Correlation measurements between signals of neutron noise and fuel element oscillations in the ECO reactor proved that fuel element oscillations can be detected by neutron noise measurements. The standard deviation of reactivity fluctuations caused by these oscillations can also be estimated from the neutron noise. (GE)

20119 ANALYSIS OF THE PHYSICAL PARAMETERS OF THE ANNA CRITICAL ASSEMBLY. Dabrowski, C.; Malewski, S. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 10, 474-494(1973).

The analysis of several systems of the ANNA critical assembly is described with the aim to determine the physical parameters and properties of the assembly at critical states. The analysis has consisted essentially in the determination of few-group diffusion parameters of the individual zones of the systems and in calculations of criticality. The results of calculations are presented and compared with the available experimental evidence. The role of some neutron processes in the systems investigated and their influence on integral parameters have been considered. Also the geometrical and material parameters of the assembly are included. (auth)

20120 MEASUREMENTS OF THE FUEL CLADDING TEMPERATURE IN STEADY STATE OPERATION OF THE EWA-10 RESEARCH REACTOR. Strupczewski, A.; Nycz, C. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 10, 455-471(1973).

The reactor EWA-10 has been working at 8 MW power since 1967. In order to determine the maximum admissible reactor power and the corresponding safety margin, the measurements of fuel cladding temperatures in steady state operation of the reactor were performed with an instrumented fuel assembly inserted into various positions in the core. The hot spots were found and the temperatures measured for reactor power from 4 to 12 MW for a number of cases. The correlation between the fuel cladding temperatures and the core loading including irradiation channel contents, fuel element burn-up and control rod positions was established. A functional dependence between the temperature drops and bulk water temperature was also determined. The results show that the reactor may be operated at power levels up to 12 MW without exceeding admissible temperatures of fuel cladding. (auth)

20121 ADVANCED REACTOR PHYSICS CALCULATION FOR THE IRR-1. Hoffmann, A. (Israel Atomic Energy Commission, Yavne); Rothenstein, W. pp 12-14 of Transactions of the Israel Nuclear Society. Vol. 1. Yavne, Israel; Israel Nuclear Society (1973).

From annual meeting of the Israel Nuclear Society; Yavne, Israel (26 Jun 1973).

Advanced reactor physics calculations for the IRR-1 was mandatory due to the replacement of the MIR fuel elements with the SILOE type fuel elements. The principal aims in the calculations were: determination of the peak-to-average power density ratio; and calculation of the effective multiplication factor. (INIS)

Production and Materials Testing and Processing Reactors

20122 (BNWL-B-88) PRELIMINARY RESULTS OF THE LOSS-OF-COOLANT HEAT TRANSFER STUDY FOR N-REACTOR. Sutey, A. M.; Fitzsimmons, D. E.; Collingham, R. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1971. Contract AT(45-1)-1830. 16p. Dep. NTIS $3.00.

Driver fuel cladding, process tube and graphite temperatures were experimentally simulated with an electrically heated test assembly to establish the rate of radiation heat transfer from the fuel to the process tube following a loss-of-coolant incident in the N-Reactor. This information is necessary as supporting data and verification for the analytical description of such an incident. The available results of the first three of a total of six experiments are presented. These results are suitable to allow DUN to evaluate, modify, and calibrate the MELT Code which is used to analytically describe the loss-of-coolant incident in N-Reactor. (auth)

20123 (STI/DOC-10-151) GUIDE TO THE COSTING OF WATER FROM NUCLEAR DESALINATION PLANTS. 1973 Edition. Starmer, R.; Lowes, F. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 88p. IAEA $4.00.

Information on the costs involved with constructing and operating desalination plants is presented under the following headings: ground rules and general observations; cost of steam from nuclear reactors; cost of steam from fossil-fueled boilers; power plant considerations; desalination equipment; and use of data to establish costs. (DCC)

20124 NUCLEAR FACTORY. Fishlock, D. Manage. Today; 53; 58; 60(Sep 1973).

A summary is presented of developments in the field of process heat reactors. In particular, the possibilities of the high temperature reactor are examined. The requirements of various chemical and metallurgical industries are reviewed in relation to the temperatures and efficiencies that may be expected from suitable reactors. Safety aspects are considered. The economics and mechanics of developing integral systems, possibly by international cooperation, are discussed. (UK)

Propulsion and Package Reactors

Refer also to abstracts 18247, 18786, 18789, 18790, 18793, 18795, 18798, 18801, 18802, 18805, 18806, 18809, 18850, 18873, 18984, 20219, 20290, and 20293–20297.

20125 (AI-AEC-12989) SNAP REACTOR PROGRAMS PROGRESS REPORT, NOVEMBER 1970–JANUARY 1971. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Mar 1971. Contract AT(04-3)-701. 220p. Dep. NTIS $13.00.

Declassified 31 Aug 1973.

Information on the SNAP research and development programs is presented concerning S8DR core examination, ZrH reactor engineering and design, reactor thermoelectric system engineering, thermoelectric converter development, component development, and fuel development. (DCC)

20126 (CNLM-5170) INTERIM REPORT ON A MOBILE LCRE POWERPLANT. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 19 Aug 1963. Contract AT(30-1)-2789. 40p.

Declassified 30 Aug 1973.

The principal characteristics of a military compact powerplant are described based on the Lithium-Cooled reactor Experiment (LCRE) reactor, the Pratt & Whitney Aircraft FT-12 engine, and current state-of-the-art components. Also included is a discussion of the compliance of the powerplant system with known design objectives of the present Mobile Compact Reactor (MCR). An Appendix is provided which contains a detailed description of the system, a description of each of the major components, and a statement of the development status of each component. Possibilities for future system improvements are also discussed in the Appendix. (22 references) (auth)

20127 (CNLM-5415) SPACE BRAYTON CYCLE. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 16 Mar 1964. Contract AT(30-1)-2789. 40p. Dep. NTIS $4.00.

Declassified 13 Sep 1973.

A preliminary design study is presented in sufficient detail on a SNAP-50/SPUR Brayton cycle power conversion system to determine the major component weights and to identify development problems. A general comparison was also made between the Rankine and Brayton cycles using a Saturn 1B launch vehicle with a total planar radiating surface of 1000-ft^2. The results showed that the Brayton cycle, which requires a larger specific radiator area, delivered an electrical power output of 133 kW(e) as opposed to 300 kW(e) for the Rankine system. The unshielded powerplant specific weight is about 80 pounds/kW(e) for the Brayton cycle system, as compared with a goal of 20 pounds/kW(e) for the Rankine cycle system. System analyses were performed on the simple cycle, reheat cycle, reheat cycle with regeneration, and reheat cycle with regeneration and intercooling. The pressure ratios were varied to obtain optimum conditions, based upon the maximum turbine inlet temperature of 1950°F available from a SNAP-50 primary system. From this study, it was concluded that the major problem areas are associated with high strength structural materials to contain the high temperature and high pressure gas, and the development of gas bearings. The heater and regenerator weights were evaluated using Nb–1 Zr alloy of 1500 psi strength and were found to be excessively heavy. An undeveloped, high strength tantalum alloy of 10,000 psi design strength was then used, and more acceptable weights were obtained for these components. The gas bearing data indicates that considerable development work must be performed, along with material development, before the Brayton cycle can be considered as an electrical power system for space. (auth)

20128 (CNLM-5694) COMPARISON OF THE SNAP-50/SPUR DEVELOPMENT PROGRAM WITH THAT REQUIRED FOR THE PROPOSED LUBAR POWERPLANT. Perry, P. I. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 May 1964. Contract AT(30-1)-2789. 16p. Dep. NTIS $3.00.

Declassified 19 Sep 1973.

The extent to which the current SNAP-50/SPUR powerplant development program is directly applicable to the LUBAR nuclear powerplant concept recommended by Westinghouse Astronuclear in the interim report of the Lunar Base Study is described. (auth)

20129 (COVA-750(Add.)) HAZARDS SUMMARY REPORT; TORY II-C COLD CRITICAL ASSEMBLY. Morton, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1963. Contract W-7405-eng-48. 62p. Dep. NTIS $5.25.

Declassified 27 Nov 1973.

The Tory II-C reactor is the prototype model of a nuclear ramjet engine. Its design is based in part upon experience gained from tests of the Tory II-A reactor. The cold critical experiments will be performed in the shielded "C" containment vault in the critical facility of the Lawrence Radiation Laboratory, Livermore. For the experiments planned, the power level is not expected to exceed 100 watts. The purpose of the cold critical experiments is to empirically determine various characteristics of the reactor, including the position of the rod bank at critical, control rod worths, absolute power and power distribution, and the temperature coefficient. As currently planned, the reactor core components will be assembled by the Propulsion Engineering Division. When the mechanical assembly is complete, the core will be delivered to the Critical Assembly Research Group for performance of the critical experiments. If the position of the control rod bank at critical should not be acceptable, the reactor will be returned to the custody of the Propulsion Engineering Division for the necessary modifications. The scope of this hazard summary includes only the critical measurements. Mechanical assembly of the reactor core and core modifications are specifically excluded. (auth)

20130 (DC-60-8-15) FOLDED FLOW RAMJET PROPOSAL. Thomson, W. B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 3 Aug 1960. Contract AT(11-1)-171. 11p. Dep. NTIS $3.00.

Declassified 12 May 1970.

Preliminary calculations on a folded flow ramjet reactor have been made. This reactor is of the P122 type with Nichrome wire fuel elements and zirconium hydride moderator. At M = 2.8 and an altitude of 1000 feet the thrust is 51,000 pounds, the overall power plant diameter is 50 inches and the maximum average wire temperature is 1975°F. For the SLAM application, this folded flow reactor is competitive with the high temperature ceramic reactors usually associated with ramjets. (auth)

20131 (DCL-60-8-72) HIGH ALTITUDE RAMJET THERMODYNAMIC RELATIONSHIPS. Clara, E. A. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 2 Aug 1960. 7p. Dep. NTIS $3.00.
Declassified 13 May 1970.
The thermodynamic characteristics of a reactor are presented for a ramjet 48 inches diameter at the design point of Mach 4 and 60,000 feet. (auth)

20132 (GA-8505) LISA: A COMPUTER PROGRAM FOR THE ANALYSIS OF HEAT REJECTION IN THERMIONIC REACTORS. Heath, C. A.; DeMichele, D. W. (Gulf General Atomic Co., San Diego, Calif. (USA)). 7 Feb 1968. 60p. Dep. NTIS $5.00.
Declassified 28 Nov 1973.

20133 (GEMP-302) PRESENTATION OF 710 REACTOR TECHNOLOGY DEVELOPMENT PROGRAM TO THE U. S. AIR FORCE, JUNE 9, 1964. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). [nd]. 41p. Dep. NTIS $4.25.
Declassified 21 Sep 1973.
Information on the 710 Reactor development program is presented concerning design characteristics of the reactor, reactor applications, and component fabrication. (DCC)

20134 (GEMP-333) 710 REACTOR PROGRAM, PROGRESS REPORT NO. 12. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 Jan 1965. Contract AT(40-1)-2847. 76p. Dep. NTIS $6.00.
Declassified 4 Sep 1973.
Information on the development of the 710 Reactor is presented concerning the performance testing of refractory-metal fuel elements, critical experiment mockup of 710 Reactor, reactor component design and development, and test facilities and pilot loop design. (DCC)

20135 (GEMP-349) 710 REACTOR PROGRAM, PROGRESS REPORT NO. 13. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 Mar 1965. Contract AT(40-1)-2847. 63p. Dep. NTIS $5.25.
Declassified 4 Sep 1973.
Information on the development of the 710 Reactor is presented concerning the performance testing of refractory-metal fuel elements, critical experiment mockup of 710 Reactor, reactor component design and development, and test facilities and pilot loop design. (DCC)

20136 (GEMP-514) SELECTION OF 710 REFERENCE REACTOR. Reid, R. E.; Semple, E. L.; Simpson, J. D. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). May 1967. Contract AT(40-1)-2847. 17p. Dep. NTIS $3.00.
Declassified 5 Sep 1973.
A reactor configuration and operating conditions are selected for a 200 kW(e) Brayton cycle space power system as a reference point for the 710 Reactor fuel systems development program and for studies of the effects of the reactor and space power system designs on the 710 Reactor fuel system. (auth)

20137 (GE-NMP-62-17) STUDY OF BRAYTON CYCLE SPACE POWER SYSTEMS. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 9 Jul 1962. 12p. Dep. NTIS $3.00.
Declassified 28 Nov 1973.
A program for the development of a fast-spectrum refractory metal reactor was recently initiated at GE-NMPO by the Atomic Energy Commission. The development and test of an experimental reactor of this type is planned. The reactor is a compact, high power density reactor which offers the capability of providing gas at temperatures in excess of 3000°F for extended periods of time. The reactor should also permit multiple restarts and rapid power changes. The specific operating life of the reactor varies of course, inversely with gas temperature. Many applications of this reactor are contemplated. Preliminary studies were made of its use in a nuclear rocket and in a compact, closed-cycle power pack for marine propulsion or for a power supply in isolated areas. Other potential applications such as space power; compact, mobile, energy supply; etc., were given brief consideration. At the request of the Atomic Energy Commission, a study was made, during a two-week period, of the application of the fast-spectrum, refractory metal reactor to a Brayton cycle space power system. The basic study contemplated a system with a one-megawatt electrical power output. A single extrapolation was made to the level of 100 kilowatts. Because of the short time available, maximum effort was applied to a semi-optimization of the radiator which is, in this type of system, the heaviest item. No attempt was made at optimization of the other components or of the total system. (auth)

20138 (GKSS-73-E-14) INVESTIGATION OF PROPELLER-INDUCED VIBRATIONS ON BOARD THE N. S. "OTTO HAHN". Research Report No. 20. Hoffmann, L.; Jassmann, B.; Wurst, G.; Voigt, P. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1973. 105p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.
Investigations to analyze the vibrations induced by the propeller in the stern of the nuclear ship "Otto Hahn" are reported. Considerable power and momentum changes have been observed during operation with the four-bladed propeller, due to the non-uniform wake, which led to vibrations in the stern of the ship. The values measured within the range of the propeller race showed a great amount of relatively strong vibrations for the four-bladed propeller. The wake analyses carried out on five and six-bladed propellers strongly supported the choice of a six-bladed propeller for the "Otto Hahn". As operation has shown, use of this propeller reduced the observable vibrations considerably. Measured data show the improvement obtained. (GE)

20139 (GKSS-73-E-21) N. S. "OTTO HAHN": TEST REPORT NO. 30. Start-up and First Operating Time of the Reactor of the N. S. "Otto Hahn" With the 2nd Core. Boettcher, G.; Brodale, V.; Goehr, L.; Kolb, M.; Puch, B.; Ramus, A.; Robinson, E.; Schnegelsberg, W.; Schumacher, W.; Schwieger, E.; Voeltzer, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (F. R. Germany)). 1973. 74p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.
An account of the zero-power and performance tests carried out from the end of March to the beginning of April 1973 after the restart of the reactor of the N. S. "Otto Hahn" following the insertion of the second core is presented. The plant has been operated to reach full power in five stages. It has been shown that the engineered safeguards of the system worked as intended during all test operations and that the safety limits have in no case been exceeded. (GE)

20140 (GKSS-72-E-33) NATURAL CONVECTION TEST ON FDR-1 OF "OTTO HAHN". Test Report No. 29. Fulfs, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1972. 43p. (In Germany). Dep. NTIS (U. S. Sales Only) $4.25.
Experiments were carried out on the stationary behavior of the primary cycle with natural convection to check the corresponding calculations. The amount of natural convection was determined by a heat balance on the steam generator. Comparing the run and the calculated natural convection capacity (each about 25% of the rated capacity) showed that the actual amount of natural convection (some 7.5% of the rated throughput) lags behind the calculated one (about 16% of the rated throughput), where the inlet sub-cooling rises to over 30°K. The discrepancy can be explained by the under estimation of the loss of pressure in the primary cycle with a small throughput. The undefined behavior of the swing check valves prove to be a further uncertainty factor. The experiment was reproduced on a graph where the measured values are plotted against the experimental time. From previous cold measurements and the present results, the characteristic resistance line of the FDR-1 has been corrected. (GE)

20141 (NAA-SR-6440) TERMINAL REPORT, PLUTO PROGRAM AT ATOMICS INTERNATIONAL. Carniglia, S. C. (Atomics International, Canoga Park, Calif. (USA)). 30 Jun 1961. Contract AT(11-1)-GEN-8. 44p. Dep. NTIS $4.25.
Declassified 26 Nov 1973.

20142 (NAA-SR-12030) IRRADIATION PERFORMANCE OF A FULL-SCALE PROTOTYPE SNAP 2 REACTOR FUEL ELEMENT (NAA 82-1 IRRADIATION EXPERIMENT). Buck, J. S.; Krupp, W. E.; Park, T. A. (Atomics International, Canoga Park, Calif. (USA)). 15 Aug 1967. Contract AT(04-3)-701. 85p. Dep. NTIS $6.25.
Declassified 28 Nov 1973.
The NAA 82-1 irradiation experiment was designed to demonstrate the performance on a full-scale reference SNAP 2 fuel element when subjected to an environment which simulated the most severe conditions (i.e., peak temperature, burnup, and burnup rate) encountered in a SNAP 2 reactor core upgraded to

produce 125 kW(t). This experiment was irradiated for twenty-three reactor cycles in the Materials Testing Reactor and was discharged on August 16, 1965. The fuel element achieved its design peak burnup of 0.08 metal at.% in an equivalent of one year at full power. The design peak cladding temperature of 1300°F (which is nominally equivalent to a peak fuel temperature of 1507°F) was maintained within ±50°F during 93.4% of the time that the reactor was at full power. The post-irradiation condition of the fuel element and the irradiation assembly was excellent. Both the uranium–zirconium hydride fuel rod and the Hastelloy-N cladding were intact and in excellent condition. The performance of the fuel element, in terms of suitability for use under 125 kW(t) SNAP 2 reactor conditions, was completely satisfactory. The design, analysis, fabrication, in-pile operation, and post-irradiation examination and evaluation of the NAA 82-1 experiment are described. (27 references) (auth)

20143 (TID-3633) RAM-JET PROPULSION BY NUCLEAR REACTORS. A Literature Search. Lanier, S. F. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Aug 1962. 19p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.
A total of 130 references are presented which cover research and development reports on the subject of nuclear reactors for ramjet propulsion. The references were taken from Abstracts of Classified Reports (ACR) and cover the subject up through May 31, 1962. The ACR volume and abstract numbers are given in each case to allow easy access to abstracts of the reports. References are arranged by issuing agencies which are listed in alphabetical order. (auth)

20144 (TIM-877) PRELIMINARY INVESTIGATION OF VENTED CORE REACTOR CONCEPTS FOR SPACE APPLICATIONS. Wunsch, W. F. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 Apr 1965. Contract AT(30-1)-2789. 26p. Dep. NTIS $3.50.
Declassified 31 Aug 1973.
Vented core reactor concepts are investigated to determine the possible advantages of this approach, compared to non-vented fuel element concepts such as the PWAR-20. The vented core concept most adaptable to space applications such as the SNAP so/SPUR is described. This approach is compared with the non-vented reactor concept. (14 references) (auth)

20145 (UCID-4059) NUCLEAR POWERED RAMJETS. Reynolds, H. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1959. 15p. (AERL-05570). Dep. NTIS $3.00.
Declassified 27 Nov 1973.
Design parameters and performance characteristics of a nuclear powered ramjet missile are presented. The test configuration for the Tory-2A Reactor is included. (DCC)

20146 (UCID-4196) NEUTRONIC CHARACTERISTICS OF THE TORY II-A-1 TEST REACTOR. PTN No. 210. Hampel, V. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Sep 1960. 47p. Dep. NTIS $4.50.
Declassified 18 Aug 1966.
The predicted neutronic behavior of the first PLUTO test reactor is described. At first a reappraisal of criticality is made in consideration of the best parameter data at hand. It is found that an excess reactivity of nine cents can be computed at the design point. The effects on reactivity due to the more accurate determination of certain parameters have been such as to cancel each other in most cases. Tory II-A-1 is expected to go critical at a control vane angle of 43 degrees, assuming a temperature of 300°K, fully withdrawn vernier control rods, and the presence of all components as they are presently scheduled for the final assembly at the Nevada Test Site. At full power operating conditions, the reactor should maintain criticality at a control vane angle of 69 degrees. In this state and at a power level of about 156 megawatts, the average core temperature should be approximately 1350°K and the deviation of radial power density from a flat profile should be not more than ± 2-3%. (auth)

20147 (UCID-4424) TORY II-A HIGH POWER TESTS OPERATIONAL DATA SUMMARY. Part I. Pluto Technical Note No. 250. Varljen, T. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jan 1962. Contract W-7405-eng-48. 54p. Dep. NTIS $4.75.
Declassified 26 Nov 1973.

20148 (UCID-4424(Add.)) TORY II: A HIGH POWER TESTS OPERATIONAL DATA SUMMARY. Part II. Addendum to PTN No. 250. Varljen, T. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Apr 1962. 39p. Dep. NTIS $4.00.
Declassified 26 Nov 1973.
Information on the Tory-2A high power tests is presented concerning the nuclear instrumentation, control system, air process system, and core thermocouple averaging system. Test results are presented for the intermediate power test and the high power tests 1, 2, and 3. (DCC)

20149 (UCID-4449) FINAL SUMMARY OF IMPURITIES IN BERYLLIUM OXIDE AS USED IN THE TORY II-A-1 REACTOR. Pluto Technical Note No. 257. Hampel, V. E.; Moran, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Feb 1962. Contract W-7405-eng-48. 23p. (COPP-62-7). Dep. NTIS $3.25.
Declassified 26 Nov 1973.

20150 (UCID-4632) BERYLLIUM FRONT REFLECTOR INSULATION THICKNESS. PTN-A No. 288. Pierce, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Nov 1963. Contract W-7405-eng-48. 2p. Dep. NTIS $3.00.
Declassified 8 Oct 1971.

20151 (UCID-4644) INCREASE OF REACTOR DIAMETER IN THE CURRENTLY DESIGNED SLAM MISSILE. PTN-A No. 292. Moyer, J. H.; Rodean, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Dec 1963. 5p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.

20152 (UCID-4649) EVALUATION OF THE GAIN IN REACTOR PERFORMANCE DUE TO VARIED AXIAL FUEL LOADING. PTN-A No. 295. Cole, A. G.; Moyer, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1963. 11p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.
The complex fuel loading pattern of the Tory II-C reactor has resulted from a sophisticated consideration of its application as a ramjet engine. An idealized reactor power profile was derived directed toward optimizing the transfer of heat energy to the airstream. Some twenty-six classes of fueled tubes have been used to tailor both axial and radial reactor power profiles accordingly. Procedures for the fabrication of components and assembly of the reactor have consequently become tedious and lengthy to safe-guard against errors. The calculations presented were done to estimate the price, in terms of engine performance, of one simplification in design. At present the Tory II-C reactor has an axial fuel loading pattern with concentrations decreasing in six steps. The simplification considered is the removal of this axial variation while preserving the radial power profile. Neutronics calculations were done with the Angie code to find the resulting power profile. This in turn provided the input for the reactor performance code DASH N. (auth)

20153 (UCID-4650) INCREASED RAMJET PERFORMANCE FOR TORY II-C. Pluto Technical Note-A No. 294. Cole, A. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1963. Contract W-7405-eng-48. 6p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.
Neutronics calculations for increased performance of the Tory-2C engine are presented. (auth)

20154 (UCID-4674) EFFECT OF AXIAL POWER DISTRIBUTION ON VEHICLE THRUST: HAND ESTIMATE. PTN-A No. 287. Mintz, M.; Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1963. 14p. Dep. NTIS $3.00.
Declassified 27 Nov 1973.

20155 (UCID-4686) PRELIMINARY REPORT ON AIR FORCE REACTOR: PERFORMANCE. PTN-A No. 307-A. Moyer, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Mar 1964. 9p. Dep. NTIS $3.00.
Declassified 27 Nov 1973.
A preliminary analysis of the reactor system proposed by LRL has been performed. The figures presented are representative, but must be expected to change slightly as design work continues. Machine calculations were performed with FLOSS III and its companion programs, NOMAC and DASH N. (auth)

20156 (UCRL-5176) APPARATUS FOR TESTING NUCLEAR ROCKET CORE MATERIALS. Heckman, R. A.; Vorek, W. E.; Gust, W. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Apr 1958. Contract W-7405-eng-48. 44p. Dep. NTIS $4.25.
Declassified 28 Nov 1973.
The general design and special instrumentation problems in the construction of an experimental apparatus for conducting performance tests on potential nuclear rocket motor core materials are outlined. A detailed discussion of the solution of these prob-

lems and the accuracies of the experimental methods adopted is included. (8 references) (auth)

20157 (UCRL-5484) TORY II-A: A NUCLEAR RAMJET TEST REACTOR. Hadley, J. W. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Nov 1959. Contract W-7405-eng-48. 291p. Dep. NTIS $16.75.
Declassified 28 Nov 1973.
The first test reactor in the Pluto program, leading to development of a nuclear ramjet engine, is called Tory II-A. While it is not an actual prototype engine, this reactor embodies a core design which is considered feasible for an engine, and operation of the reactor will provide a test of that core type as well as more generalized values in reactor design and testing. The design of Tory II-A and construction of the reactor and of its test facility are described. Operation of the Tory II-A core at a total power of 160 megawatts, with 800 pounds of air per second passing through the core and emerging at a temperature of 2000°F, is the central objective of the test program. All other reactor and facility components exist to support operation of the core, and preliminary steps in the test program itself will be directed primarily toward ensuring attainment of full-power operation and collection of meaningful data on core behavior during that operation. The core, 3 feet in diameter and 4½ feet long, will be composed of bundled ceramic tubes whose central holes will provide continuous air passages from end to end of the reactor. These tubes are to be composed of a homogeneous mixture of UO_2 fuel and BeO moderator, compacted and sintered to achieve high strength and density. (30 references) (auth)

20158 (UCRL-5829) PLUTO QUARTERLY REPORT NO. 2, OCTOBER–DECEMBER 1959. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1960. Contract W-7405-eng-48. 195p. Dep. NTIS $11.75
Declassified 28 Nov 1973.
Information is presented concerning Tory-2A neutronics, air flow control system, instrumentation, heat transfer, and components; fabrication and mechanical properties of BeO and BeO–UO_2; performance testing of graphite reflector; and Tory-2C neutronics, control rod drives, and engineering. (DCC)

20159 (UCRL-6036) PLUTO QUARTERLY REPORT NO. 4, APRIL–JUNE 1960. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1960. Contract W-7405-eng-48. 146p. Dep. NTIS $9.50.
Declassified 27 Nov 1973.
Information is presented concerning Tory-2A neutronics and thermodynamics; reactor control system; performance of core structures; physical properties of BeO–UO_2; and design characteristics of Tory-2C. (DCC)

20160 (UCRL-6143) PLUTO QUARTERLY REPORT NO. 5, JULY–SEPTEMBER 1960. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1960. Contract W-7405-eng-48. 70p. Dep. NTIS $5.50.
Declassified 26 Nov 1973.
Information is presented concerning Tory-2A neutronics, reactor control systems, and component testing; mechanical properties of BeO and BeO–UO_2; and Tory-2C neutronics, control rod drives, and component testing. (DCC)

20161 (UCRL-6238) APPLICATION AND EVALUATION OF CERAMIC MATERIALS IN TORY REACTOR SYSTEMS. Moyer, J. H.; Myers, W. B.; Walter, C. E.; Wells, W. M. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1960. Contract W-7405-eng-48. 35p. Dep. NTIS $3.75.
Declassified 26 Nov 1973.
The Tory series of test reactors is intended to lead to a reactor capable of use as a ramjet power plant. Current designs are presented. Beryllium oxide is presently the only serious contender as the moderator. Analytical and experimental treatment of the thermal stress problem in BeO is discussed. There is a requirement that a ramjet reactor sustain very large forces caused by flow-induced pressure drop. Development of ceramic structural elements to sustain these forces is discussed. (6 references) (auth)

20162 (UCRL-6376) PLUTO QUARTERLY REPORT NO. 7, JANUARY–MARCH 1961. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Apr 1961. Contract W-7405-eng-48. 191p. Dep. NTIS $11.75.
Declassified 26 Nov 1973.
Research during the quarter included neutronics, aerothermodynamics, and engineering for Tory IIA and Tory IIC and Materials development and pilot plant activities. (JWR)

20163 (UCRL-6516) PLUTO QUARTERLY REPORT NO. 8, APRIL–JUNE 1961. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jul 1961. Contract W-7405-eng-48. 268p. Dep. NTIS $15.50.
Declassified 26 Nov 1973.
Information is presented concerning Tory-2A power tests; fuel element fabrication; physical properties of BeO, UO_2, and UO_2 mixtures; Tory-2C physics calculations; Tory-2C control rod drives; and performance testing of Tory-2C core structures. (DCC)

20164 (UCRL-6625) PLUTO QUARTERLY REPORT NO. 9, JULY–SEPTEMBER 1961. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1961. Contract W-7405-eng-48. 220p. Dep. NTIS $13.00.
Declassified 26 Nov 1973.
Information is presented concerning Tory-2A power tests; fuel element performance; physical properties of BeO–UO_2; Tory-2C neutronics; and Tory-2C control system and core structures. (DCC)

20165 (UCRL-6726) PLUTO QUARTERLY REPORT NO. 10, OCTOBER–DECEMBER 1961. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jan 1962. Contract W-7405-eng-48. 280p. Dep. NTIS $11.00.
Declassified 26 Nov 1973.
Information is presented concerning Tory-2A power tests; fuel element fabrication; physical properties of BeO, UO_2, and UO_2 mixtures; Tory-2C physics calculations; Tory-2C control rod drives and control system electronics; and fabrication and performance testing of Tory-2C core structures. (DCC)

20166 (UCRL-6829-T(Summ.)) PLUTO AEROTHERMODYNAMIC TRANSIENTS. Rodean, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Mar 1962. 5p. Dep. NTIS $3.00.
Declassified 27 Nov 1973.

20167 (UCRL-6840-T(Summ.)) THERMODYNAMIC PERFORMANCE OF THE TORY IIA REACTOR. Moyer, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1962. 4p. Dep. NTIS $3.00.
Declassified 27 Nov 1973.

20168 (UCRL-6842-T(Summ.)) TORY II-C PERFORMANCE PARAMETERS. Var, R.; Uthe, P. M.; Mintz, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Mar 1962. Contract W-7405-eng-48. 10p. Dep. NTIS $3.00.
Declassified 27 Nov 1973.

20169 (UCRL-6846-T(Summ.)) DETERMINATION OF THE CRITICAL MASS AND OF SPATIAL FUEL DISTRIBUTION OF THE TORY II-C REACTOR. Hampel, V. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Mar 1962. Contract W-7405-eng-48. 10p. Dep. NTIS $3.00.
Declassified 27 Nov 1973.

20170 UCRL-6887-T(Summ.)) NEUTRONIC ANALYSIS OF TORY II-A-1 HIGH POWER OPERATION. Hampel, V. E.; Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1962. Contract W-7405-eng-48. 8p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.
The reactor kinetics parameters of the Tory IIA-1 reactor determined in the high power performance test are discussed. The observed characteristics are compared with values predicted by neutronic calculations. (JWR)

20171 (UCRL-6890) PLUTO QUARTERLY REPORT NO. 11, JANUARY–MARCH 1962. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Apr 1962. Contract W-7405-eng-48. 187p. Dep. NTIS $11.50.
Declassified 26 Nov 1973.
Information is presented concerning Tory-2A disassembly operations; BeO and ceramic materials properties; and Tory-2C neutronics, control system, and core structures. (DCC)

20172 (UCRL-6992) PLUTO QUARTERLY REPORT NO. 12, April–June 1962. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1962. Contract W-7405-eng-48. 231p. Dep. NTIS $13.75.
Declassified 26 Nov 1973.
Information is presented concerning the disassembly of the Tory-2A core; fuel element fabrication; physical properties of BeO; Tory-2C physics calculations; Tory-2C control rod drives and control system electronics; and Tory-2C core structures. (DCC)

20173 (UCRL-7036(Pt.2)) STRUCTURE OF REACTOR: PART 2 OF THE TORY II-C PROGRAM. Walter, C. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Sep 1962. Contract W-7405-eng-48. 24p. Dep. NTIS $3.25.

Declassified 26 Nov 1973.

Information on the Tory-2C Reactor is presented concerning the reactor core structure, core supports, fuel assemblies, and control rods. (DCC)

20174 (UCRL-7036(Pt.4)(Sec.A)) DESIGN ASPECTS: NEUTRONIC DESIGN. Part 4 (Section A) of the Tory II-C Program. Goldberg, E.; Hampel, V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jan 1963. Contract W-7405-eng-48. 64p. Dep. NTIS $5.25.

Declassified 26 Nov 1973.

Information is presented concerning nuclear parameters, critical mass, and reactor control system. (DCC)

20175 (UCRL-7036(Pt.4)(SB)) DESIGN ASPECTS: RADIATION EFFECTS, PART 4 (SECTION B) OF THE TORY II-C PROGRAM. Lorenz, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1963. Contract W-7405-eng-48. 62p. Dep. NTIS $5.25.

Declassified 26 Nov 1973.

The interaction of radiation with the reactor components and environment plays an important role in the design of Tory II-C. Nuclear heating of structural components and the resulting temperature distributions have been found to be of primary importance in the thermodynamic design considerations. Radiation flux fields external to the reactor are such that the use of most organic-material components, such as insulation, gaskets, O-rings, etc., has been restricted to materials compatible with high radiation and temperature. Activation of reactor components and the activity of the core itself have dictated the design of both the zero site bunker and disassembly building. The radiation-effects design aspects of the Tory II-C reactor are described. The sources and spatial distributions of gamma and neutron radiation in and around the reactor are discussed. The tools developed and the methods used to calculate such quantities as heating, structural damage, and activation of materials are presented together with the results of the calculations. (25 references) (auth)

20176 (UCRL-7036(Pt.4)(SC)) DESIGN ASPECTS: HEAT TRANSFER AND FLUID FLOW. Part 4 (Section C) of the Tory II-C Program. Mintz, M. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jan 1963. Contract W-7405-eng-48. 37p. Dep. NTIS $4.00.

Declassified 26 Nov 1973.

Operating characteristics of the Tory IIC reactor associated with heat transfer and fluid flow are presented. (JWR)

20177 (UCRL-7036(Pt.7)) TORY II-C TEST VEHICLE. Part 7 of the Tory II-C Program. Behne, J. C.; Pitts, J. H.; Anderson, N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Dec 1962. Contract W-7405-eng-48. 20p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

The railroad flatcar and all the equipment used as the test vehicle for the Tory IIC reactor are described. The components described include all equipment on the flatcar with the exception of the reactor, reactor controls, and instrumentation. The safety features of the test vehicle are discussed. (JWR)

20178 (UCRL-7036(Pt.9)) TORY II-C OPERATIONS. Part 9 of the Tory II-C Program. Barnett, C. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Dec 1962. Contract W-7405-eng-48. 15p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

Testing procedures and personnel requirements for the Tory-2C are presented. The emergency plan is described. (DCC)

20179 (UCRL-7036(Pt.10)) TORY II-C HAZARDS OF OPERATION: PART 10 OF THE TORY II-C PROGRAM. Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Dec 1962. Contract W-7405-eng-48. 36p. Dep. NTIS $4.00.

Declassified 26 Nov 1973.

The Tory II-C reactor, as a possible engine for a nuclear ramjet vehicle, differs in many respects from the more conventional power reactors now in use. It must operate at extremely high temperatures and power levels and yet have a minimum of shielding associated with it. The further demands of flight application require fast control capability, with the actuators located in a hostile environment. Structural components must be strong enough to withstand the high g-loadings expected during maneuver. Under such circumstances, it was deemed necessary that reactor tests be conducted in a remote area, well removed from large population centers. Tests for the Pluto program are therefore conducted at Site 401, Nevada Test Site of the AEC. It will be shown below that even when incredible accidents are postulated, the radiation hazard to offsite people is orders of magnitude less serious than that resulting from atmospheric tests of low yield (i.e. 1 kt) weapons. Operational findings from the Tory II-A program are cited, and models either consistent with these or even more conservative are employed to predict the Tory II-C behavior. 20 references. (auth)

20180 (UCRL-7079) PLUTO QUARTERLY REPORT NO. 13, JULY-SEPTEMBER 1962. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Oct 1962. Contract W-7405-eng-48. 171p. Dep. NTIS $10.75.

Declassified 26 Nov 1973.

Information is presented concerning Tory-2C neutronics, and instrumentation; stress testing of core structures; BeO physical properties; and fabrication of BeO-UO_2 fuel elements. (DCC)

20181 (UCRL-7249) TORY II-A REACTOR TESTS. Final Report. Hadley, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 May 1963. Contract W-7405-eng-48. 226p. Dep. NTIS $13.50.

Declassified 26 Nov 1973.

Tory II-A was the first reactor in a series which will lead to development of a nuclear-powered ramjet engine in the Pluto program. The core embodied a design which is believed to be useable in an actual engine. All parts external to the core were intended only to form a suitable test bed, and had no relation to flyable hardware. Test operations were conducted during the period December 1960-October 1961. On May 14, 1961, following several months spent in low-power measurements and facility shakedown, the reactor was brought to 50 MW power (½ design) and 2580°F core temperature (300° above design) for a period of about one minute. All systems operated properly, and no indication of any damage was obtained. After a period of facility alterations, to provide the capability of delivering test air at higher temperature and pressure, the reactor was run three times at power levels approaching or in excess of the design operating value of 160 MW. The second of these tests fully achieved design operating conditions, and the third substantially exceeded them in severity. Again no indications of failure were noted during operation. Disassembly of the reactor has confirmed that it maintained its structural integrity. In general confirmation of previous experimental data, thermal stress cracks were found in many fuel element walls. Fewer cracks than expected, however, were found in the hottest part of the core, indicating that considerable stress relief through creep must have occurred. Even among the elements which cracked, no instance was found in which an air flow passage was blocked. 18 references. (auth)

20182 (UCRL-7315) TORY II-C DATA BOOK. Walter, C. E.; Smiley, P. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jun 1963. Contract W-7405-eng-48. 360p. Dep. NTIS $20.00.

Declassified 26 Nov 1973.

Information on Tory-2C is presented concerning reactor performance, neutronics, design parameters, test program, and physical properties of reactor materials. (DCC)

20183 (UCRL-7317) PLUTO QUARTERLY REPORT NO. 15, JANUARY-MARCH 1963. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1963. Contract W-7405-eng-48. 135p. Dep. NTIS $8.75.

Declassified 26 Nov 1973.

Research during the quarter included neutronics and engineering studies on Tory IIC, materials development and pilot plant activities, Tory III engineering studies, and a review of Tory IIC thrust performance. (JWR)

20184 (UCRL-7369) CRACKING IN TORY II-A FUEL TUBES. Robinson, E. Y.; Wells, W. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Oct 1963. Contract W-7405-eng-48. 200p. Dep. NTIS $12.00.

Declassified 26 Nov 1973.

20185 (UCRL-7442) PLUTO QUARTERLY REPORT NO. 16, APRIL-JUNE 1963. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Jul 1963. Contract W-7405-eng-48. 135p. Dep. NTIS $8.75.

Declassified 26 Nov 1973.

Information is presented concerning Tory-2C physics calculations; control rod drives; core structures; fuel element performance; and physical properties of BeO. (DCC)

20186 (UCRL-7546) PLUTO QUARTERLY REPORT NO. 17, JULY-SEPTEMBER 1963. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Oct 1963. Contract W-7405-eng-48. 128p. Dep. NTIS $8.50.

Declassified 26 Nov 1973.

Information is presented concerning Tory-2C neutronics, thermodynamics, control rod drives, and core structures; and mechanical properties of BeO and coating materials. (DCC)

20187 (UCRL-7649) PLUTO QUARTERLY REPORT NO. 18, OCTOBER–DECEMBER 1963. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jan 1964. Contract W-7405-eng-48. 127p. Dep. NTIS $8.50.

Declassified 26 Nov 1973.

Research progress made during the quarter is reported. The research included reactor physics and engineering studies on Tory IIC, development of ZrO_2 and Y_2O_3 coatings for BeO, metallurgy studies on cobalt alloy L-605, and development of non-nuclear components for Tory IIC. (JWR)

20188 (UCRL-7665) TORY II-C REACTOR COLD CRITICAL ASSEMBLY PROGRAM. Morton, J. R. III; Varlijen, T. C.; Petruzzi, J. Jr.; Piowaty, J. M.; Gardner, L. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jan 1964. Contract W-7405-eng-48. 95p. Dep. NTIS $6.75.

Declassified 27 Nov 1973.

The cold critical experiments with the Tory II-C reactor were performed in the critical facility of the Lawrence Radiation Laboratory at Livermore. The reactor is described briefly; the experimental equipment and the arrangement for the experiments is described in detail. The core poison was removed without difficulty, and criticality was achieved at 1624 hours July 14, 1963. With the design core configuration the shutdown margin was less than had been intended; criticality was attained at a shim rod bank position of 38.5 inches insertion rather than the expected 35 inches. All Hastelloy tie tubes were replaced by René-41. A heated core experiment with $\Delta T = 129 \pm 7°F$ above room temperature provided a measure of the temperature coefficient which was found to be $-3.9 \times 10^{-3} \pm 7\%$ inch of shim rod bank travel/°F. Other experiments included flux mapping, using fission foils, fission counters and copper flux wires, transients to determine control element worths, studies of flux spectrum by means of threshold detectors, and measurements of multiplication for various shutdown configurations for purposes of operational safety. Transient measurements, critical rod configurations, and flux distributions were also measured with the core poisoned in various stages to simulate elevated temperatures. 12 references. (auth)

20189 (UCRL-7679) ENGINEERING DESIGN OF THE TORY II-C NUCLEAR RAMJET REACTOR. Walter, C. E. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1964. Contract W-7405-eng-48. 414p. Dep. NTIS $22.75.

Declassified 27 Nov 1973.

The Tory II-C nuclear ramjet reactor is the culmination of the Lawrence Radiation Laboratory's development efforts in the Pluto program from 1957 to 1964. Details of the design and assembly of the reactor are presented. Included are descriptions, criteria, analyses, and computations of the core components, axial and transverse reactor support systems, and reactor controls. In addition, a detailed description of the assembly of the reactor is profusely illustrated. Not included are discussions of reactor control actuators, electronic systems, etc. (auth)

20190 (UCRL-7825) PLUTO QUARTERLY REPORT NO. 19, JANUARY–MARCH 1964. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Apr 1964. Contract W-7405-eng-48. 141p. Dep. NTIS $9.25.

Declassified 27 Nov 1973.

Research progress made during the quarter is reported. The research included reactor physics and engineering studies on Tory IIC, development of ceramic coatings for BeO, and testing of ball bearings of cobalt L-605 alloy for the Tory IIC control rod actuator. (JWR)

20191 (UCRL-7933) FINAL TORY IIC PERFORMANCE BULLETIN. Mintz, M.; Jester, M.; Moyer, J.; Pierce, G.; Rodean, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Oct 1964. Contract W-7405-eng-48. 124p. Dep. NTIS $8.25.

Declassified 27 Nov 1973.

The aerothermodynamic performance characteristics of the Tory IIC reactor are described. The results of an extensive analytic study of the system are presented. The reactor is treated both from the standpoint of a nuclear ramjet heat source and a test stand device. In an effort to provide as complete a coverage as possible the data are displayed in graphical form. By means of the charts and tables presented the reader may evaluate the aerothermodynamic performance of Tory IIC over an extensive range of operating conditions. A brief discussion of the mathematical models and techniques employed in the analysis is also presented. Experimental data from the Tory IIC nuclear power runs are analyzed and found to be in excellent agreement with analytic predictions derived previously. 11 references. (auth)

20192 (UCRL-7956) PLUTO QUARTERLY REPORT NO. 20, APRIL–JUNE 1964. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1964. Contract W-7405-eng-48. 167p. Dep. NTIS $10.50.

Declassified 27 Nov 1973.

Information is presented concerning Tory-2C operations and testing; reactor kinetics; control system and instrumentation; and physical properties of ceramic materials. (DCC)

20193 (UCRL-7993) TORY IIC-AF: AN ENGINE DESIGN FOR A NUCLEAR RAMJET MISSILE. Goldberg, E. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jul 1964. Contract W-7405-eng-48. 103p. Dep. NTIS $7.25.

Declassified 27 Nov 1973.

Information is presented concerning Tory-2C neutronics, radiation effects, thermodynamics, control rod drives, and performance of BeO Coatings. (DCC)

20194 (UCRL-12069) TORY IIC REACTOR TEST REPORT. Reynolds, H. L. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Oct 1964. Contract W-7405-eng-48. 229p. Dep. NTIS $13.50.

Declassified 26 Nov 1973.

A report on the intermediate and full power tests of the Tory IIC reactor is presented. An analysis of reactor performance is included. (JWR)

20195 (UCRL-12257(Summ.)) TORY IIC NEUTRONIC ANALYSIS. Goldberg, E.; Hampel, V. E.; Cole, A. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1964. Contract W-7405-eng-48. 8p. Dep. NTIS $3.00.

Declassified 27 Nov 1973.

20196 (UCRL-12258(Summ.)) AEROTHERMODYNAMIC PERFORMANCE ANALYSIS OF THE TORY IIC HIGH POWER NUCLEAR EXPERIMENTS. Mintz, M. D.; Kellman, S.; Jester, M.; Pierce, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1964. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

Declassified 27 Nov 1973.

An evaluation of the aerothermodynamic performance of the Tory IIC reactor and components is presented. The analytical procedures used in performing the evaluation are discussed. (JWR)

20197 (UCRL-12259) TORY IIC-AF: A PRACTICAL NUCLEAR RAMJET REACTOR DESIGN. Moyer, J. H.; Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1965. Contract W-7405-eng-48. 39p. Dep. NTIS $4.00.

Declassified 27 Nov 1973.

Information on the Tory-2C is presented concerning mechanical arrangement, neutronics, aerodynamics, and thermodynamics. (15 references) (DCC)

20198 (UCRL-12259(Summ.)) TORY IIC-AF: A PRACTICAL NUCLEAR RAMJET REACTOR DESIGN. Moyer, J. H.; Cole, A. G.; Walter, C. E.; Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1964. Contract W-7405-eng-48. 8p. Dep. NTIS $3.00.

Declassified 27 Nov 1973.

Design parameters and performance characteristics of the Tory-2C-AF ramjet reactor are presented. (DCC)

20199 (UCRL-12262(Summ.)) MEASUREMENTS AND ANALYSIS OF NUCLEAR RADIATION FROM TORY IIC. Lorenz, A.; Kellman, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1964. Contract W-7405-eng-48. 13p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

Three experiments designed to measure and analyze nuclear radiation effects were performed at the Nevada Test Site during the May 1964 power test runs of the Tory IIC reactor. The purpose of this effect has been to substantiate analytical estimates made in conjunction with the development of the Tory IIC reactor, and to provide useful data for future reactor tests. These experiments have proven to be of great benefit and have demonstrated the usefulness of small simple peripheral experiments conducted during the testing of Tory IIC. While in some instances the experiments have indicated certain aspects which need refinement, in other cases they have yielded data which, in view of the simplicity of the experiments, have surpassed their anticipated accuracy. (auth)

20200 (UCRL-12263) TORY IIC TEST OPERATIONS. Barnett, C. (California Univ., Livermore (USA). Lawrence

Livermore Lab.). 12 Mar 1965. Contract W-7405-eng-48. 28p. Dep. NTIS $3.50.
Declassified 26 Nov 1973.

20201 (UCRL-12263(Summ.)) TORY IIC TEST OPERATIONS. Barnett, C. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1964. Contract W-7405-eng-48. 7p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.
The test program for the Tory IIC reactor is summarized. The qualification testing of the test facility as well as the actual reactor tests are described. (JWR)

20202 (UCRL-12278) PHOTOGRAPHIC DETERMINATION OF REACTOR COMPONENT TEMPERATURES DURING NUCLEAR OPERATIONS. Werner, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1965. Contract W-7405-eng-48. 39p. Dep. NTIS $4.00.
Declassified 27 Nov 1973.
Temperatures of the Tory IIC reactor base plates were continuously monitored with color motion-picture film. Density changes in the film caused by heat-radiation exposure allowed absolute temperature determinations within ±5% at the temperatures encountered during test. Temperature differences of 25°F were consistently detectable. The overall techniques involved in making the temperature measurements, from the initial step of producing a calibration film through the final readout of the exposed film, are discussed in detail. The effect of gamma fogging, turbulent air, energy absorption, emissivity, wavelength, film response, etc. on the integrity of the film is considered. Comparison with fiducial temperature markers in the system is discussed. The technique of using "density amplification" to spot regions of particular interest (i.e., possible hot spots) and the correlation of this with normal temperature readout is discussed. The advantage of using the three separate emulsion layers of the color film with their individual spectral response curves is reviewed. (auth)

20203 (UCRL-12282) ANALYSIS OF SIDE SUPPORT PRESSURE REQUIREMENT FOR NUCLEAR REACTORS SUBJECT TO MANEUVER LOADS. Miller, A. B.; Platt, E. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Apr 1965. Contract W-7405-eng-48. 63p. Dep. NTIS $5.25.
Declassified 27 Nov 1973.
Certain design criteria are analyzed for the structure providing side support within a cylindrical duct for an air-cooled reactor core constructed of a large bundle of small tubes. The structure performs two related functions: (1) it supplies clamping pressure to stabilize the tube array, (2) it transmits transverse loads between the reactor duct and core. Various instabilities which could occur with insufficient bundle pressurization are described for an array of hexagonal tubes. Support systems are characterized as radial, tangential, or a combination. For analysis the tube array is pictured as an elastic solid so long as slips and separations are suppressed. Loads and stresses throughout the array are derived with the Airy stress function. Results are plotted against ratio of radial to tangential flexibility in the side support. Required pressures are related to the hydrostatic pressure in a fluid of the same average density and dimensions as the core. Brief mention is made of: (1) effect of side support flexibility on a coupled inertia-neutronic excursion mode, (2) weight optimization of side support springs in accommodating core thermal expansion and differential duct thermal and pressure expansion, and (3) some novel support schemes that have been proposed. 7 references. (auth)

20204 (UCRL-12286) FLOW CONTROL IN THE TORY REACTOR-DUCT ANNULUS. Brown, N. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Apr 1965. Contract W-7405-eng-48. 14p. Dep. NTIS $3.00.
Declassified 26 Nov 1973.
In the case of a reactor confined within a high pressure duct, differences in thermal capacitances between the reactor core and the duct can result in significant variations in thickness in the core-duct annulus during transient reactor operation. Enough room must be provided for at normal operating conditions to allow for cold duct–hot core conditions during a fast startup. This minimum allowable annulus dimension is increased at cold core—hot duct conditions resulting from sudden power reductions, or from a fast shutdown. Some metering system is required to provide adequate duct and side support coolant flow in this region and still insure that the static pressure at any point matches that at a corresponding position in the core, within allowable limits. The design of a system of orifices based on roll-over type springs used in the Tory reactors is described. The program of testing is discussed. (auth)

20205 (UCRL-12296) EFFECTIVE SPECIFIC IMPULSE OF A PULSED ROCKET ENGINE. Platt, E. A.; Hanner, D. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 May 1965. Contract W-7405-eng-48. 23p. Dep. NTIS $3.25.
Declassified 26 Nov 1973.
The highest effective specific impulse to be expected from a nuclear-pulsed rocket motor is calculated with respect to the weight of the motor. (DCC)

20206 (UCRL-12308) TORY REACTOR TEMPERATURE MEASUREMENTS. Russell, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Apr 1965. Contract W-7405-eng-48. 33p. Dep. NTIS $3.75.
Declassified 26 Nov 1973.
The basic problem to be dealt with was how to continuously measure temperatures in the active core of a reactor that was to be operated as a high-temperature heat exchanger with compressed air used as the cooling medium. Some 345 to 375 measurements were made on the Tory IIA and IIC reactors. Measurements in the reactor core involved complicated and specialized problems, and are discussed. (auth)

20207 (UCRL-12391) PLUTO FUEL ELEMENT FABRICATION AT LAWRENCE RADIATION LABORATORY. Sandholtz, W. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Feb 1965. Contract W-7405-eng-48. 32p. Dep. NTIS $3.75.
Declassified 26 Nov 1973.
Development of an extrusion-based process for producing beryllia fuel elements for the Pluto nuclear powered ramjet is described. The goal was to extrude and fire hexagonal tubes to close dimensional tolerances without grinding. Sinterable beryllia powder was fueled by precipitating uranium and fuel additives from a single aqueous solution in which the beryllia had been slurried. After sintering, the fuel phase consisted of a phase-stabilized solid solution of urania (UO_2) with yttria and zirconia. Principal operations consisted of slurrying and precipitation, filtration, drying and calcination, vehicle incorporation and mixing, extrusion, drying and vehicle burnout, and hydrogen sintering (including straightening). Directions for continued development toward the "no grinding" goal are pointed out. (auth)

20208 (UCRL-13169) SUMMARIZING TECHNICAL REPORT FOR RESEARCH AND DEVELOPMENT TASK PART 4A. Task No. 4. Additives Investigation. Part 4A. Halo Contamination. Final Report, May 1–September 30, 1963. Hartert, G. (Coors Porcelain Co., Golden, Colo. (USA)). 15 Oct 1963. Subcontract 165. 18p. (CPC-873). Dep. NTIS $3.00.
For Univ. of California, Livermore. Declassified 26 Nov 1973.
The findings of an extensive investigation into the identity and source of the contaminant which causes "halo" defects in fired fueled tubes are presented. Results reported previously (refer to First and Second Technical Progress Reports) are reviewed briefly and the results of recent experiments are included in detail. In addition, specific recommendations aimed at elimination or alleviation of the "halo" contamination problem are included. (auth)

20209 (UCRL-13176) SUMMARIZING TECHNICAL REPORT FOR RESEARCH AND DEVELOPMENT TASK PART 3A. Binder Evaluation. Final Report, May 1, 1963–January 31, 1964. McDermott, J. (Coors Porcelain Co., Golden, Colo. (USA)). 15 Feb 1964. Contract W-7405-eng-48. 20p. (CPC-932). Dep. NTIS $3.00.
Declassified 26 Nov 1973.
While considerable effort was originally expended in the search and selection of a binder system for use in the production of fuel elements for Tory II-C, it was felt that re-evaluation of the binder system with special emphasis on new types of binders would be worthwhile. An improved binder system could yield substantial benefits in the area of improved extrudability, by reducing pigtailing and surging, thereby increasing extruder yield, and by improving control over fired size through achieving consistent shrinkage. This study was composed of two major parts: screening of all binder types which might be useful in this application; and the complete evaluation of the most promising binders. (auth)

20210 (UCRL-14363) TORY IIC EFFLUENT GAS SAMPLING. Ackerman, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Sep 1965. Contract W-7405-eng-48. 34p. Dep. NTIS $3.75.
Declassified 26 Nov 1973.
Isokinetic gas and particulate samples were collected from reactor effluent during the two Tory IIC power runs to determine the loss of fuel-element materials and the release of radioactive fission products. The dual sampling system, designed to with-

stand a blast velocity of 600 ft/sec at 500°F, was located 164 ft downstream from the reactor nozzle. Particulates and iodine were trapped on a filter. The gas was compressed into a leachable, lined bottle. Samples were taken during the high-power plateau of each run. Minor damage suffered during the final run did not seriously affect the samples. Results indicate a sample dilution of 6.3 to 1 and 5.6 to 1, respectively, for the two tests. Samples obtained during run 89 allowed a unique prediction of the reactor core temperature during that run. 15 references. (auth)

20211 SECOND CORE FOR THE REACTOR OTTO HAHN. Com. Naz. Energ. Nucl., Notiz.; 19: No. 10, 107-109(Oct 1973). (In Italian).

20212 ANNUAL REPORT OF JAPAN NUCLEAR SHIP DEVELOPMENT AGENCY. Nippon Genshiryokusen Kaihatsu Jigyodan Nenpo; No. 46, 1-129(Oct 1971). (In Japanese).

The hull of the nuclear ship "Mutsu" was almost completed in 1969 in Tokyo No. 2 Works of IHI, and mounting of the secondary shield in the reactor room was carried out from April to June, 1970. After adjustment, finishing, and inspection, a sea trial with an auxiliary boiler was carried out on June 29 and 30 off Tateyama in Tokyo Bay. Mutsu was delivered on July 13 by IHI to the Agency after delivery inspection, and brought to the usual mooring port in Mutsu City, Aomori Prefecture, for installation of a reactor. Kobe Shipyard of Mitsubishi Heavy Industries has engaged in manufacture of the reactor parts. The main machinery such as a pressure vessel, core structure, steam generators and main cooling pumps was completed by November 1970, and auxiliary machinery such as heat exchangers, tanks, pumps and ion exchange towers was completed by October 1970. Production and inspection of control instrumentation and electric machinery were finished, and manufacture of pipings was started. Installation of the main reactor parts on board and preparation for hydrostatic test were completed by March 1971. Production of nuclear fuel was started in June 1970, and completion is expected in July 1971. Dredging and other works to be made before arrival of the Mutsu in the usual mooring port were finished by June 1970. Radiation control equipment has been prepared, and training of a crew is under way. (JA)

Reactor Safety and Environmental Aspects

Refer also to abstracts 18319, 18322, 18342, 18346, 18356, 18385, 18386, 18390, 18905, 20011, 20037, 20053, and 20324.

20213 (BNWL-CC-225) FINAL SAFEGUARDS ANALYSIS, HIGH TEMPERATURE LATTICE TEST REACTOR. Hanthorn, H. E.; Brown, W. W.; Clark, R. G.; Heineman, R. E.; Humes, R. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1966. Contract AT(45-1)-1830. 207p. Dep. NTIS $12.50.

Information on the HTLTR Reactor is presented concerning: reactor site; reactor buildings; reactor kinetics and design characteristics; experimental and test facilities; instrumentation and control; maintenance and modification; initial tests and operations; administration and procedural safeguards; accident analysis; self-terminated excursions; main heat exchanger leak; training program outline; and reliability analysis of safety systems. (7 references) (DCC)

20214 (CENPD-42(Rev. 1-1)) TOPICAL REPORT ON DYNAMIC ANALYSIS OF REACTOR VESSEL INTERNALS UNDER LOSS-OF-COOLANT ACCIDENT CONDITIONS WITH APPLICATION OF ANALYSIS TO CE MWe CLASS REACTORS. (Combustion Engineering, Inc., Windsor, Conn. (USA). Nuclear Power Dept.). [nd]. 124p.

In the design process of nuclear reactor vessel internals, hypothetical accidents are postulated and the dynamic response of the reactor vessel internals to these accidents is examined. The incident considered is the loss-of-coolant accident resulting from a double-ended pipe rupture in the primary coolant system. A safe shutdown earthquake is assumed to occur simultaneously. The methodology that is used to analyze the dynamic response of reactor vessel internals under these accident conditions is described. The dynamic analysis computer programs utilized are discussed, together with their verification. The dynamic analysis methods are applied to C-E pressurized water reactors of the 800 MW(e) class. Results are obtained in terms of stresses and displacements and compared to allowables. These results obtained for the 800 MW(e) class reactors show that at no time during or after the above postulated incidents do the displacements or stresses exceed the established allowables. (auth)

20215 (CONF-731126-1) MECHANISM OF LIQUID-LIQUID CONTACT AND HEAT TRANSFER RELATED TO FUEL-COOLANT INTERACTIONS. Fauske, H. K. (Argonne National Lab., Ill. (USA)). 1973. 10p. Dep. NTIS $3.00.

From second specialist meeting on sodium fuel interaction in fast reactors; Ispra-Varese, Italy (21 Nov 1973).

The requirements for explosive boiling (vapor explosion) are discussed with special emphasis on the UO_2-Na system. Considerations include requirements for direct liquid-liquid contact and associated heat transfer characteristics. Fragmentation and explosive boiling are treated as separate phenomena. (auth)

20216 (HW-14058) HAZARDS OF WASTE STORAGE AT HANFORD WORKS. Parker, H. M. (Hanford Works, Richland, Wash. (USA)). 2 Aug 1949. 60p. Dep. NTIS $5.00.

The potential environmental hazards of radioactive fission product dissemination as the result of earthquakes, sabotage, or enemy bombing of a Hanford reactor are evaluated. From the nature of the process these reactors are major waste storage units. The following subjects are discussed: quantity of radioactive waste in a Hanford reactor; activity of key fission products, effects of cooling water loss; fallout from the explosion of reactor and the effects of this fallout on air, ground, and water contamination; contamination of the Columbia River; biological effects on man and animals; and the radionuclide migration through the food chain as result of river water contamination. Estimates are made of the potential hazard due to radioactive clouds, and two models are developed for defining the gross contimaination of the Columbia River. (LCL)

20217 (JAERI-M-5339) STUDY ON THE CODE CONTEMPT: AN ANALYTICAL MODEL FOR THE CONTAINMENT TEMPERATURE AND PRESSURE BEHAVIOR. Ishikawa, M.; Sato, K.; Aoyama, T.; Koseki, M.; Hatta, H. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. 85p. (In Japanese). NTIS (U. S. Sales Only).

The code CONTEMPT, developed in the National Reactor Testing Station, the United States, has been studied in the Nuclear Code Committee of JAERI. The purpose is to examine its feasibility in safety evaluation of the light-water reactor plants through the analysis of containment transient experiments, Carolina Virginia Tube Reactor containment experiment in the United States and semi-scale blow-down experiment in a ship reactor container. The code reproduces the experimental results accurately when some key inputs such as heat transfer coefficients of the structure surface are given suitably. (auth)

20218 (RISO-M-1650) APPLICATION OF STATISTICAL LINEAR ELASTIC FRACTURE MECHANICS TO PRESSURE VESSEL RELIABILITY ANALYSIS. Becher, P. E.; Pedersen, A. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1973. 29p. (CONF-730942-2). Dep. NTIS (U. S. Sales Only) $3.50.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An evaluation of the failure probability for a pressure vessel is made on the basis of LEFM (Linear Elastic Fracture Mechanics). Failure is identified as actual crack length (i.e. stress intensity factor K_I) being equal to critical crack length (i. e. plain strain fracture toughness K_{IC}). The probability of failure is the joint probability that a crack (i.e. K_I) exists that is larger than a given crack (i.e. K) and that the critical crack (i.e. K_{IC}) is smaller than that same crack, where K_I and K_{IC} are considered for the same time and location. K_{IC} as well as K_I are treated as statistical variables with probability density functions, which are functions of material, initial cracks, stresses, and crack growth. The integrated calculations of failure probability are performed by a computer program utilizing the Monte Carlo method with importance sampling. (auth)

20219 (TM-62-9-1) SAFETY ANALYSIS OF A GRAPHITE ROCKET REACTOR. Gamertsfelder, C. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). Mar 1961. Contract AT(40-1)-2847. 15p. Dep. NTIS $3.00.

Declassified 27 Nov 1973.

The safety aspects of both ground testing and flight testing of rocket reactors are presented. (DCC)

20220 (WARD-2171-11) ANALYTICAL EVALUATION OF FUEL FAILURE PROPAGATION FOR THE FAST FLUX TEST FACILITY. Coffield, R. D.; Wattelet, P. L. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1970. Contract AT(45-1)-2171. 154p. AT.

An analysis of fuel failure and failure propagation phenomena in the FFTF reactor is presented. The analysis is divided into

three major sections: fuel failure phenomena; fuel failure propagation phenomena; and response of major barriers to fuel failure propagation phenomena. The analysis demonstrates the margin of safety that is designed into the FFTF reactor with respect to fuel failure propagation. (JWR)

20221 SAFETY AND RELIABILITY OF NUCLEAR POWER PLANT. Crancher, D. W.; Greenslade, G. K. (Australian Atomic Energy Commission, Lucas Heights). At. Energy Aust.; 16: No. 3, 14-22(Jul 1973).

Accidental release into the environment of radioactive waste materials generated in the reactor core is considered. A summary of the annual whole-body dose rates from various sources of exposure in the USA is given. Loss of coolant accidents caused by pipe failures and pressure vessel failures are considered. A discussion is given on the reliability of primary cooling circuits, codes and standards, quality control, in-service inspection, and licensing and regulatory controls. Emergency cooling provisions are described. (AT)

20222 NUCLEAR POWER PLANTS. Safety Aspects of the Concerted Action of Operating Personnel and Reactor Plant. Lindackers, K. H. (Technische Ueberwachungs, Cologne). Sicherheitsingerieur; 4: No. 9, 422-427(1973). (In German).

A nuclear power plant can be considered as a man-machine system (MMS) aimed at the conversion of nuclear energy into electrical energy by the most suitable way. Disregarding the fact that the component "man" is of considerable importance in the operation of a nuclear power plant, research in the field of reactor safety was limited in the past chiefly to technical and scientific aspects. For example, the education and examination of reactor operating personnel in the United States is controlled by detailed instructions. In the Federal Republic of Germany similar prescriptions do not yet exist. Results from other MMS show that the concerted action of operating personnel and reactor plant could be improved. (GE)

20223 COMPARISON OF UK AND US REQUIREMENTS FOR SAFETY AND SITING OF NUCLEAR POWER PLANTS. Richardson, J. A. (Burns and Roe, Inc., New York). Nucl. Eng. Int.; 18: No. 210, 884-890(Nov 1973).

Nuclear reactor siting criteria are based on safeguarding the public from the results of the hypothetical one-time design base accident and from the effects of continuous release of radioactive effluents to the environment. Siting procedures in the U. K. since 1956, with reported radioactive releases, are compared with U. S. regulations and plant operating data. (auth)

20224 NUCLEAR SAFETY. Volume 15, No. 1, January–February 1974. Cottrell, W. B.; Jordan, W. H.; Sheldon, M. R. (eds.). A Bimonthly Technical Progress Review Published for the Technical Information Center, USAEC. Oak Ridge, TN; Oak Ridge National Laboratory (1974). 132p. GPO $0.60.

Separate abstracts are presented for 8 articles containing information on general safety considerations, control and instrumentation, plant safety features, consequences of effluent release, and operating experiences. (DCC)

For abstracts of individual papers see: 20010, 20011, 20225–20227, 20300, 20398, and 20399.

20225 POPULATION DOSES FROM THE NUCLEAR INDUSTRY TO 2000 A.D. Nucl. Safety; 15: No. 1, 56-76(1974).

During the next few decades, it is anticipated that the nuclear power industry in the United States will undergo a remarkable growth. To project the effect of this growth on the radiation doses of the general public, the U. S. Atomic Energy Commission made a review of current reactor operating experiences. From this review a detailed analysis of the radiation dose to a major section of the country due to effluents from nuclear facilities for conditions projected for the year 2000 was undertaken. The study indicates that the average dose to the U. S. population from nuclear power will increase from an estimated 0.003 mrem per person in 1970 to as much as 0.2 mrem in the year 2000. This contribution remains a small fraction of the radiation dose from either natural or man-made sources of ionizing radiation. 71 references. (auth)

20226 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Casto, W. R. (Oak Ridge National Lab., TN). Nucl. Safety; 15: No. 1, 79-85(1974).

All reports of occurrences that were received by the Nuclear Safety Information Center at Oak Ridge National Laboratory between Aug. 27 and Nov. 1, 1973 (over 200), were scanned for the information given, which differ only in the condition of the facility at the time of the occurrence. In the "Cause" column in the tables, "Human" indicates an operator mistake, whereas "Procedure" indicates that the procedure itself was in error. A brief description of each incident is included, along with the reactor, facility, or institution at which the incident occurred. The docket number and the date of the event are included where appropriate so that interested readers may obtain copies of the reports from the AEC Public Document Room in Washington, D.C. (auth)

20227 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN SEPTEMBER AND OCTOBER 1973. Casto, W. R. (Oak Ridge National Lab., TN). Nucl. Safety; 15: No. 1, 85-88 (1974).

Of the safety-related occurrences reported between Aug. 27 and Nov. 1, 1973 several are discussed in detail here because of their frequency, uniqueness, or significance. Items selected for discussion include recurrent explosions in the off-gas system of Vermont Yankee; the malfunction of valves in nuclear power plants; reports from licensees on seismic shock absorbers; a relief-valve failure at Pilgrim that depressurized the reactor; flow-channel problems in the Vermont Yankee and Pilgrim power reactors; and a feedwater-valve failure at Ginna that caused a water hammer. 11 references. (auth)

20228 METHOD FOR DECONTAMINATION OF SURFACES OF NUCLEAR REACTOR COMPONENTS. Korn, R.; Seyd, G.; Paulsen, U. (to Siemens Aktiegesellschaft). US Patent 3,778,938. 18 Dec 1973. Priority date 17 Feb 1971, F.R. Germany. 4p.

Cleaning radioactively contaminated surfaces and components of nuclear power reactors is carried through by means of a sand-blasting technique, wherein boron trioxide sand is used as the blasting medium. The process is carried out such that the passivation layer on the surfaces to be cleaned is not attacked and that water is used for flushing out the blasting materials which may have remained on the surfaces which have been cleaned. (Official Gazette)

20229 SAFETY ASSESSMENT FOR ADDITION OF NO. 6 REACTOR AT FUKUSHIMA NUCLEAR POWER PLANT OF TOKYO ELECTRIC POWER CO. LTD. Genshiryoku Iinkai Geppo; 17: No. 11, 12-25(Nov 1972). (In Japanese).

The results of an investigation on safety factors concerning the installation of the Fukushima-6 power plant are discussed on the basis of the written application for permission for reactor installation in Dec. 21, 1971. The investigation was based on the principle that the safety of the general public and employees be guaranteed even if an unexpected event might occur. The aim of the investigation was to inspect the safety measures to be adapted according to the guide of reactor installation, guide for safety design, and regulation standards on permissible exposure dose under the provisions of reactor installation and operation specified in the 21st report of the Science and Technology Agency in 1960 for minimum release of radioactive substances based on the recommendations of the International Commission on Radiological Protection. The contents of the investigation were environmental conditions for installation, protection measures of reactor equipment, nuclear materials management and exposure evaluation during ordinary operation (management of radioactive wastes, radiation management within the building site, and radiation protection outside the power plant), safety measures against various kinds of accidents, estimation of accidents (estimation of radiation exposure dose in accidents of coolant loss, and technical capacity. The investigation confirmed the safety of the reactor installation. (JA)

20230 CONTAINMENT SYSTEM FOR NUCLEAR REACTORS. Bevilacqua, F.; West, J. M. (to Combustion Engineering, Inc.). German Patent 1,589,657. 26 Jul 1973. 2p. (In German).

A plant is described, which in the case of a reactor accident, carries the non-condensable radio-active residual gas atmosphere to a decontamination apparatus by means of a circulating device. The safety system will rapidly come into operation in cases of accident and is constructed to enable regular testing, even during reactor operation. (GE)

20231 SITING OF NORWAY'S FIRST NUCLEAR POWER PLANT. State Power Board's Thermal Power Group Has Presented Proposed Site Choice. Electro; No. 8, 21; 30(19 Apr 1973). (In Norwegian).

As a result of a comprehensive study of possible sites in the Oslofjord district Norges Vassdrags- og Elektrisitetsvesen (NVE) have proposed that Emmerstad or Mörk in Vestby should be the site for the first Norwegian nuclear power plant. Since the recipient situation is not finally evaluated Vardeåsen Li in Rygge is proposed as a reserve site. Should district development factors make siting on the East side of the Fjord undesirable a site in the Hurum peninsula is feasible. These conclusions, published in NVE's report "Location of Nuclear Power Plant in the Oslofjord District", are presented in this review of the report. The procedures to be adopted in consultation with

the various governmental bodies concerned in reaching a final choice are discussed in some detail. (NO)

20232 SAFETY OF NUCLEAR POWER PLANTS. Is There a Danger to the Environment. KWU-Rep.; 26: No. 10, 1-6(1972). (In German).

Comments put forward by the Kraftwerkunion on the campaigns for environmental protection in the FRG (nuclear controversy) are presented. (GE)

20233 PENETRATION OF A SOLID LAYER BY A LIQUID JET. Buchanan, D. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., D (London); 6: No. 15, 1762-1771(8 Oct 1973).

The resistance of a solid layer to penetration by a liquid jet has been calculated for a variety of target geometries and in both the high and low jet-velocity regimes. The theory is applied to the penetration of an aluminium layer by a water jet and a uranium dioxide layer by a sodium jet. It is thought that the violent interaction that may occur when a hot liquid (fuel) comes into contact with a cold vaporizable liquid (coolant) is due, in part, to penetration of the fuel by jets of liquid coolant, and the results presented here indicate that the thickness of the solid layer to be expected on the fuel is not an insurmountable barrier to jet penetration of the liquid fuel. (auth)

20234 ENERGY CRISIS. Global Perspective. Thorstensen, B. (Kungliga Tekniska Hoegskolan, Stockholm). Tek. Ukebl.; 120: No. 39, 34-43(20 Sep 1973). (In Norwegian).

The earth's energy balance is discussed and the quality of the energy considered, i.e. to which extent it adds thermal energy to the system. The tendency to exponential growth is commented on and it is stated that within 100 years, by using all available power sources, the global average atmospheric temperature could be raised by 0.25° C. It is claimed that the radiation hazards from a power reactor program are so significant as to require great caution. The present policies and proposals for radioactive waste disposal are attacked as irresponsible. It is also claimed that reactor accident statistics are unsatisfactory and that safety measures are inadequate, especially with regard to sabotage. (NO)

20235 SIZING OF POWER STATION BUILDINGS TO WITHSTAND THE STRESSES SET UP BY PLANE CRASHES AND PRESSURE WAVES. Dietrich, R.; Fuerste, W. (Krupp (Friedr.) GmbH, Essen). Tech. Mitt. Krupp, Forschungsber.; 31: No. 3, 99-112(1973). (In German).

From second international conference on structural mechanics in reactor technology; Berlin, Ger. (10 Sep 1973).

Suitable structural measures must be taken in the design of nuclear power station buildings to protect the public from external effects such as plane crashes and pressure waves. The problems encountered in dimensioning the wall thickness of power station buildings to protect them from such hazards are analyzed and solutions are indicated. Results obtained are presented and discussed. (GE)

20236 ENVIRONMENTALLY FAVORABLE DRY-TYPE COOLING. Trautmann, H. (WIBERA Wirtschaftsberatung AG, Duesseldorf). Energ. Tech.; 25: No. 11, 286-288(Nov 1973). (In German).

The article reviews a study by H. Wolf, discussing the question of whether the change from water cooling to air cooling in electricity generation will be technically feasible and economically justifiable in the near future. A comparison of the data given in this study on additional costs with other data from the latest publications shows an agreement of the conclusions drawn by the various authors as far as the general trend is concerned, but with regard to the absolute amount of additional expenses, the results are quite different. It is stated that the change from fresh water to dry-type cooling is a must and that an increase in the generating cost is inevitable. An impact statement of the various procedures available would have been a useful supplementation of this study. (GE)

20237 ATOMIC ENERGY. pp 36-43 of Temahefte om Energi. Trondheim, Norway; SNM-Trondheim (1973). (In Norwegian).

An elementary introduction to the theory of fission and fusion is presented. Thermal and fast reactors are briefly described. Thermal pollution is mentioned and uranium resources summarized. (NO)

20238 ENERGY CRISIS: THE NORWEGIAN COMMUNITY. Thorstensen, B. (Kunghga Tekniska Hoegskolan, Stockholm). Tek. Ukebl.; 120: No. 40, 33-39(27 Sep 1973). (In Norwegian).

A brief review of Norway's energy resources is followed by criticism of the public information given by the Norwegian Water Resources and Electricity Board (NVE) on the need for nuclear power and the planned program. A discussion of reactor safety, based on WASH-740, is presented, and the philosophy e.g., in evaluating the safety of containers for irradiated fuel transport is criticized. The policy in radioactive waste disposal is also criticized. It is also stated that Oslofiord is not suitable as a cooling water recipient. It is further stated that the NVE is both the advisory and the executive body in energy questions, which is an undesirable situation. Finally, after pointing out that the per capita energy consumption in Norway is very high a number of proposals for reducing energy consumption are given. (NO)

20239 INCIDENT IN THE WUERGASSEN NUCLEAR POWER PLANT. Causes and Course of the Incident and Problem Solutions. Consequences for Further Projects. Voight, O. (Kraftwerk Union AG, Frankfurt am Main); Koch, E. Atomwirt., Atomtech.; 18: No. 12, 584-592(Dec 1973).

From reactor meeting; Karlsruhe, Ger. (10 Apr 1973).

The causes and course of the incident in the Wuergassen nuclear power station, the improvement measures taken, the optimization of the opening characteristics of the valves, and the measurements during the test phase are described in detail. With a view to future systems of this type, it is stated that the reduction of blowdown pressures by means of nozzles for pressure distribution and the re-enforcement of the pressure suppression chamber will guarantee the safe functioning of the pressure relief system under any conceivable stress conditions. (GE)

20240 REACTOR SAFETY DESIGN FOR NUCLEAR POWER PLANTS DEMONSTRATED ESPECIALLY FOR A POWER PLANT WITH A BWR TYPE REACTOR. Preusche, G. (Kraftwerk Union AG, Frankfurt am Main). Energ. Tech.; 25: No. 9, 231-236(1973). (In German).

In the design of nuclear power plants, all sorts of imaginable malfunctions must be taken into consideration. Safety systems are provided which introduce suitable and well-timed counter actions. For boiling water reactors the main perturbance types are discussed and it is shown which corresponding process variable introduces suitable safety actions. (GE)

Reactor Theory and Calculation

Refer also to abstracts 19907, 19908, 20048, and 20107.

20241 (AEEW-M-809) SUPERPOSITION OF BUCKLING MODES ON TO CELL CALCULATIONS AND APPLICATION IN THE COMPUTER PROGRAMME WDSN. Brissenden, R. J.; Green, C. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Mar 1968. 19p. Dep. NTIS (U.S. Sales Only) $3.00. UK 50 pence.

The treatment of leakage from lattice cells has for many years been a little obscure for reactor physicists. The notable results have been obtained for the case of infinitely small leakage in directions of uniform heterogeneity and more approximately in other directions. Leslie and others have at one time or another attempted to improve on this work by considering it from the point of view of a generalized cell calculation. This work was inconclusive for a number of reasons; but nevertheless the basic ideas were sound. This topic is reopened and a satisfactory solution to the problem of a generally leaky lattice cell is found. The solution is found to be the imposition of a generalized periodic boundary condition on to the normal transport operator. It has been used in the treatment of axial leakage in the cylindrical and slab versions of WDSN and has been developed into a more general slab code FILAMENT. The program WDSN(ST) which is the program WDSN basically, but with modifications to handle streaming problems, is described. (auth)

20242 (AEEW-R-661) APPLICATION OF THE GENERALIZED PERIODIC BOUNDARY CONDITION TO THE RADIAL STREAMING PROBLEM. Brissenden, R. J. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Dec 1969. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

The general theory of leaking lattice cells developed in AEEW–M 809 is applied to the radial streaming problem. The appropriate fine structure function is reduced to a cylindricalized form suitable for calculation by the DSN technique of B. G. Carlson. Using diffusion theory the equations for the fine structure function are solved in three simple geometrical situations and the solutions are used to deduce several classical streaming formulas. The ensuing sections show how the theory is incorporated into the numerical techniques of collision probabilities and Monte Carlo for solving the transport equation. (auth)

20243 (EURFNR-1125) MIGROS-2: A PROGRAM WRITTEN IN FORTRAN FOR THE CALCULATION OF MICROSCOPIC GROUP CONSTANTS FROM NUCLEAR DATA. Huschke, H.;

Krieg, B. (comps.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jun 1973. 312p. (KFK-1784). Dep. NTIS (U. S. Sales Only) $17.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

MIGROS-2 allows the production of microscopic group constants of the ABN-type. The Karlsruhe nuclear data file KEDAK is used as the nuclear data basis. All group constants necessary for diffusion-, consistent P1-, and S_n-calculations, taking the anisotropy into account up to P_3, can be calculated. A description of the code and the underlying theory is given. An input and an output description, a sample problem and the program lists are provided. (auth)

20244 (IAE-2294) INSTRUCTIONS ON USING THE HETEROGENEOUS REACTOR CALCULATIONS PROGRAM QUAMHER. Gorodkov, S. S. (Gosudarstveenyj Komitet po Ispol'zovaniyu Atomnoj Energii SSSR, Moscow). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

QUAMHER is a FORTRAN 4 computer program designed to calculate the neutron density and flux distribution in heterogeneous reactors. The heterogeneous reactor is represented as a finite or infinite two-dimensional square lattice of thin rods imbedded in an infinite moderator. The neutron transport and slowing-down in the moderator are described by two-group diffusion equations. It is assumed that the rods interact only with thermal neutrons, which are absorbed in the rods and initiate fission neutron emission. This absorption is proportional to the mean neutron density on the surface of the rod. (auth)

20245 (INIS-mf-831) MULTICELL AND DIFFUSION CALCULATIONS OF CORES CONTAINING BURNABLE POISON RODS. Nigon, J. L.; Mondot, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1973. 23p. INIS.

From 1973 annual meeting of the Belgian section of the A. N. S.; Mol, Belgium (14 Jun 1973).

Some Babcock and Wilcox experiments with boron poison pins have been investigated at Saclay using a calculation scheme under development at C. E. A. Spectrum and transport calculations have been performed with the APOLLO code and the results used for diffusion calculations of the core. Results concerning multiplication factors of the different cores and reactivity worth of several poison rods are in very good agreement with the experimental values. (auth)

20246 (INIS-mf-832) TRIBU, a 2-DIMENSIONAL TRIANGULAR MESH DIFFUSION, BURNUP, AND FUEL MANAGEMENT PROGRAM. Minsart, G.; Peperstraete, G.; Billaux, M.; Delabaye, M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Societe Belge pour l'Industrie Nucleaire, Brussels). 1973. 2p. INIS.

From 1973 annual meeting of the Belgian section of the A. N. S.; Mol, Belgium (14 Jun 1973).

The program TRIBU (TRIangular mesh with BUrnup) is designed for the detailed fuel cycle analyses of fast and thermal reactors with hexagonal assemblies. The triangular grid used for the diffusion and the depletion calculations corresponds to mesh sizes equal to the side, to half the side or to one third of the side of the fuel assemblies; the isotopic compositions are computed at each point of this grid (7, 19 or 37 points/assembly), and the flux distributions are obtained taking into account different isotopic compositions in each sixth of the assemblies, and different axial bucklings per assembly. To the burnup chains ($^{232}Th-^{234}U$ and $^{235}U-^{236}U$, $^{238}U-^{242}Pu$) correspond two separate sets of fission products (rapidly saturating, slowly saturating, non-saturating) as well as ^{135}Xe, ^{149}Sm and ^{241}Am production. The depletion of burnable poisons (boron and samarium) is also computed. (auth)

20247 (JAERI-M-5234) TIME EIGENVALUE OF FUNDAMENTAL MODE IN FAST MULTIPLYING SYSTEMS. Hiraoka, T. (Japan Atomic Energy Research Inst., Tokyo). Apr 1973. 97p. (In Japanese). NTIS (U. S. Sales Only).

The prompt neutron decay constant observed by the pulsed neutron experiment should be the time eigenvalue of the fundamental mode for it to have the significance as a reactor constant. To investigate in what cases this eigenvalue exists, a series of the pulsed neutron experiments have been made with the fast bare systems of different neutron multiplications, i.e., an aluminium system and a lead system as non-multiplying, uranium systems as low-multiplying, and bare fast reactor systems as highly multiplying. The experimental results are analyzed by multi-group calculations of the transport theory and Storrer-Stievenart's theory with the aid of the spectrum theory of time eigenvalue, which gives the perspective to the problem concerning the conditions of systems such as their compositions and sizes. The neutron multiplication by the fission process is shown to be essential for the existence of the time eigenvalue of fundamental mode for fast systems. (auth)

20248 (JAERI-M-5307) EVALUATION OF THE TWO-DIMENSIONAL NUMERICAL CALCULATION USED IN FAST REACTOR NEUTRONICS. Seki, Y.; Osugi, T.; Iijima, S. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 52p. (In Japanese). NTIS (U. S. Sales Only).

Two-dimensional multi-group neutron diffusion codes based on finite-difference methods are extensively used in fast reactor neutronics. The reliability of the codes are evaluated through several numerical calculations. It is found that the effective multiplication factors calculated by the codes are strongly dependent on the size of the spatial mesh width of the region where the gradient of the neutron flux is large. Two-dimensional models of the real fast reactor system are used in the two-dimensional diffusion calculations. As the result, there arises the errors in the calculated effective multiplication factor due to geometrical modification in the case of RZ calculation, and the error due to the axial buckling approximation in the case of XY calculation. Under the assumption that both of the errors appear as the simple sum in one-dimensional cylindrical calculation, the two errors are calculated. Using the errors thus obtained, the effective multiplication factor of the three dimensional XYZ calculation is estimated. It is found that the two-dimensional diffusion code generally overestimate the effective multiplication factor. (JA)

20249 (JAERI-M-5325) SOME PROPERTIES OF THE HIGHER ORDER PERTURBATION METHOD. One Group Diffusion Approximation. Mitani, H. (Japan Atomic Energy Research Inst., Tokyo). Jul 1973. 30p. NTIS (U. S. Sales Only).

To know properties of the higher order perturbation method, the analytical expressions for the higher order perturbation terms up to the third order are obtained with one-group diffusion approximation in slab geometry. The higher order perturbation term is generally expressed by the product of three independent terms; i.e. the first order reactivity worth, half the level distance, and the geometrical functions depending on the perturbation region. The n'th order reactivity worth is proportional to the n'th power of the first order reactivity worth, that is, proportional to the n'th power of the concentration of the perturbation inserted. The n'th order reactivity worth is proportional to the (n-1)'th power of the reciprocal of half the level distance, so that the magnitude of the higher order reactivity worths relative to the first order reactivity worth becomes larger as the infinite multiplication factor in the system approaches 1 or the radius of the system becomes larger. If the perturbation is uniformly inserted in the whole system of a bare reactor, the neutron flux does not change and the higher order reactivity worths are zero for the perturbation where only absorption cross section changes. The properties of the higher order perturbed fluxes are also examined in detail. Further, convergence criterion is deduced from the analytical expression of the higher order reactivity worths. (auth)

20250 (ORNL-TM-4443, pp vp Paper 23) EXACT SOLUTION OF SINGULAR ARC PROBLEMS IN REACTOR CORE OPTIMIZATION VIA LIE GROUPS. Axford, R. A. (Univ. of Illinois, Urbana). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

Modern control theory and the Lie theory of local transformation groups are applied to the problem of determining fuel distributions that minimize the ratio of the critical mass to the reactor power when the power output is specified. Exact solutions of this problem are found by establishing the group invariance properties of the necessary conditions for optimality. It is shown that the extremal trajectories include singular arcs of the linear type. The classical criteria of optimality are inapplicable. Necessary conditions for optimality are obtained from a generalized Legendre-Clebsch condition, which leads to systems of nonlinear differential equations for the state variables and influence functions. Exact solutions of the nonlinear differential equations that comprise the optimality conditions are found by the following procedure. A two-parameter Lie group admitted by the necessary conditions for optimality is first deduced from the Lie derivative of these conditions. The canonical variables of the Lie group found are then calculated, and the optimality conditions are expressed in terms of these canonical variables. Finally, the canonical form of the optimality condition is integrated by quadratures, and the original variables are introduced into the resulting integral to provide the exact solution of the isoperimetric problem defined above. (auth)

20251 (USIP-73-18) SIMULATION OF THE INVERSE ZERO POWER TRANSFER FUNCTION FOR A NUCLEAR REACTOR WITH APPLICATIONS TO REACTOR TECHNOLOGY. Andersson, A. J. W. (Stockholm Univ. (Sweden). Fysiska Institutionen). Nov 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The inverse zero power transfer function of reactor physics

has been simulated with an analogue computer. The space independent reactor kinetic equations have been solved for reactivity, using the signal from an ion chamber as input data. In this way reactivity information is obtained instantaneously and continuously, provided that the variations in reactor power do not exceed the input range of the computer. The reactivity effects observed depend on the noise in the computer input signal. It is not necessary for the reactor to be critical in order to measure reactivity with this technique. This is in contrast to the methods of determining reactivity by measuring the asymptotic doubling time of reactor power or by analysing power oscillations due to reactivity variations. Another reason for introducing the analogue computer method is that it can follow a rapid sequence of reactivity variations as well as a gradual change in reactivity. A detailed description of the method, the computer programme and the equipment is given. Some applications to reactor design and operation are also outlined. 13 references. (auth)

20252 NEUTRON RATE IN A HETEROGENEOUS REACTOR. Lobyntsev, V. A.; Nosov, V, I. (Inst. of Atomic Energy, Moscow). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 24-29(1973). (In Russian).

Formulation and solution of multigroup adjoint problem in P1 approximation are presented for heterogeneous reactor. Particular attention is paid to boundary conditions. These conditions are given in general and special forms (effective boundary conditions, albedo, etc). The adjoint problem for two-dimension (r, φ) cylindrical heterogeneous reactor is tested in accordance with the described method. The results of the test are presented. (11 references) (auth)

20253 BUCKLING EFFECT IN THE INTERMEDIATE RESONANCE INTEGRAL. Saad, E. A.; El-Wakil, S. A. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 22: No. 2, 102-104(Oct 1973).

The Chernick-Vernon equation taking buckling into account is used to calculate the resonance integral in the intermediate resonance approximation. It was found that $\Delta I = I(O) - I(B)$ is increased as the value of the buckling increases. Hence, in the small system the buckling affects the resonance integral appreciably. (GE)

20254 INVESTIGATION OF NONLINEAR XENON OSCILLATION BY METHOD OF AVERAGING. Asahi, Y.; Akcasu, A. Z. (Univ. of Michigan, Ann Arbor). J. Nucl. Energy; 27: No. 12, 839-855(Dec 1973).

A nonlinear analysis of xenon-temperature controlled nuclear reactor dynamics is presented. The set of equations in question belongs to a general class of rate equations with quadratic nonlinearities. Boundedness of the solutions is examined. The mean value of periodic solutions for the flux is shown to be always less than the equilibrium value. The Bogoliubov's method of averaging as extended by Case (Unpublished, University of Michigan, 1963) is applied to obtain approximate solutions. The mechanism of the existence of relaxation-oscillations in the linear stability region is analyzed. Computer calculations are performed and found in good agreement with the approximate solutions obtained by means of the method of averaging. (auth)

20255 SMALL-SAMPLE REACTIVITY MEASUREMENTS IN NUCLEAR REACTORS. Foell, W. K. Monograph Series on Nuclear Science and Technology. Hinsdale, IL; American Nuclear Society (1972). 260p. (TID-26511).

Experimental techniques for the precise and accurate determination of small reactivities are treated in detail. The design and interpretation of small-sample reactivity measurements to obtain information about the sample material or the reactor under study are discussed. Reactivity measurements of specific parameters and with specific types of materials are evaluated for both thermal and fast reactors. (JWR)

20256 CALCULATION OF FISSION PRODUCTS RELEASE FROM PEBBLE-BED REACTORS. Herhadi, P. Aachen; Technische Hochschule (1972). 110p. (In German).

Thesis.

Using a two-region diffusion model, fission product release from coated particles is calculated under simplified assumptions. With the help of Laplace-transforms the time-dependent diffusion equations are solved with suitable boundary conditions. A second solution is based on the application of Green's functions. Both methods yield the same results. Knowing the temperature distribution throughout the reactor core, it is possible to calculate the total fission product release from a pebble-bed reactor (AVR). (GE)

20257 METHOD FOR DETERMINING THE DIFFERENTIAL REACTIVITIES OF POWER REACTORS. Fuge, R.; Ziegenbein, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 8, 245-248(Aug 1973). (In German).

During reactivity measurements in power reactors the feedback effects have to be taken into account. A method is described to determine simultaneously the control rod partial efficiencies and the parameters of the feedback. The technique has been proved at full power of the Rheinsberg pressurized water reactor; the measuring results are presented. (auth)

20258 INVESTIGATION OF THE INFLUENCE OF THE DANCOFF CORRECTION ON THE MULTIPLICATION OF FINITE PIN CONFIGURATIONS. Blank, K. H. (Technische Univ., Hanover). Atomwirt., Atomtech.; 18: No. 10, 471-472(1973). (In German).

For the LINGEN-reactor fuel rod cluster the influence of the DANCOFF-correction on the multiplication was calculated with the result that the magnitude of the correction strongly depends on the position of the cell within the cluster. Therefore one should use in precise calculations neither the DANCOFF-value for an infinite lattice nor a mean value for the whole cluster. (GE)

20259 NEUTRON DISTRIBUTION IN A SLAB REACTOR WITH MOVING BOUNDARIES. Hendry, W. L. (Los Alamos Scientific Lab., NM). SIAM (Soc. Ind. Appl. Math.) J. Appl. Math.; 22: No. 3, 487-494(May 1972). (LA-DC-12588).

The method of matched asymptotic expansions is used to obtain a solution to the neutron transport equation for a homogeneous critical slab with moving boundaries. The slab is assumed to be surrounded by a vacuum, and the one-speed approximation is used. The solution is valid asymptotically for large neutron speeds, uniformly in time. (auth)

20260 COMPARATIVE ANALYSIS AT AMERICAN AND GERMAN NUCLEAR DATA FILES FOR THE CALCULATION OF FAST FISSION REACTORS. Yiftah, S.; Gur, Y.; Segev, M.; Gitter, L. (Israel Atomic Energy Commission, Yavne). pp 6-8 of Transactions of the Israel Nuclear Society. Vol. 1. Yavne, Israel; Israel Nuclear Society (1973).

From annual meeting of the Israel Nuclear Society; Yavne, Israel (26 Jun 1973).

A code package named NANICK handling both ENDF/B-III and KEDAK via the same algorithm generating multigroup-self-shielded neutron cross sections sets and calculating physics parameters of nuclear systems has been completed and used to calculate a number of fast nuclear systems and critical experiments in a spherical approximation. These calculations are used as a tool for detecting discrepancies between nuclear data from different files. (INIS)

20261 EPITHERMAL NUCLEAR REACTOR LATTICE ANALYSIS. Karni, J.; Rothenstein, W. (Israel Inst. of Tech., Haifa). pp 15-17 of Transactions of the Israel Nuclear Society. Vol. 1. Yavne, Israel; Israel Nuclear Society (1973).

From annual meeting of the Israel Nuclear Society; Yavne, Israel (26 Jun 1973).

Utilization of neutron cross-section compilations for nuclear reactor analysis requires considerable preparatory work. The basic compilations list point cross-sections which can be used to calculate reaction rates at every neutron energy and the scattering probability for every change of direction. On the other hand detailed analysis of reactor behavior necessitates solution of the transport equation when the full geometric structure and material composition of every reactor region is taken into account. Such detail cannot be achieved except when many steps are taken to simplify the treatment as much as possible. Consequently multi-group treatments become essential. The fewer the energy groups which are used and the coarser the treatment for the angular dependence of the neutron flux, the greater the emphasis which can be given to the reactor composition and behavior. (INIS)

20262 STABILITY OF COUPLED CORE REACTOR. Shani, G. (Univ. of the Negev, Beersheva, Israel). pp 1-3 of Transactions of the Israel Nuclear Society. Vol. 1. Yavne, Israel; Israel Nuclear Society (1973).

From annual meeting of the Israel Nuclear Society; Yavne, Israel (26 Jun 1973).

One of the major problems in coupled core reactors is the instability that might occur in the system because of a transient in one of the cores. The domains of stability and instability are calculated for a two slab-core-system. The transient is simulated by a delta function source in one core. The simple time dependent diffusion equation does not give a full description of all the details of the flux's time dependence so that a more elaborated theory is needed. The P1 approximation was used to develop the second-order time dependent equation (telegraphers' equation) with a time-dependent external source. (INIS)

20263 OPTIMAL SOURCE PROJECTION METHOD FOR FAST REACTOR DYNAMIC CALCULATIONS. Saphier, D.

(Israel Atomic Energy Commission, Yavne). pp 4-5 of Transactions of the Israel Nuclear Society. Vol. 1. Yavne, Israel; Israel Nuclear Society (1973).

From annual meeting of the Israel Nuclear Society; Yavne, Israel (26 Jun 1973).

A fast method for solving the multigroup space time dependent diffusion equation has been developed and incorporated into the SHOVAV code, solving the few group space time dependent diffusion equation with temperature feedback for fast systems. The method uses various source projection modes to accelerate the solution with respect to the time variable. Polynomials of first, second and third order as well as exponentials are used as the projection algorithm. (INIS)

20264 COMPARISON OF TRANSPORT AND DIFFUSION THEORY FOR FAST REACTOR SHIELDING CALCULATIONS. Sahin, S. (Oak Ridge National Lab., TN). Atomkernenergie; 22: No. 1, 24-35(Sep 1973).

The use of diffusion theory for fast reactor shielding calculations in complex and thick configurations is questionable and it is necessary to apply transport theory to correctly solve this kind of problem. Transport calculations are carried out using the one-dimensional S_N Code ANISN. Anisotropic scattering cross sections are represented by the P_5-approximation. Neutron spectra characteristic of the proposed FFTF reactor are assumed as the neutron source and the shield consists of various combinations of iron and sodium. (GE)

Reactor Components and Accessories

Refer also to abstracts 18275, 18297, 18301, 18389, 18391, 18524, 18850, 18873, and 18874.

20265 (AECL-4606, pp 2-4) STEAM GENERATORS: CRITICAL COMPONENTS IN NUCLEAR STEAM SUPPLY SYSTEMS. Stevens-Guille, P. D. (Chalk River Nuclear Labs., Ont.). Win 1973.

Steam generators are critical components in power reactors. Even small internal leaks result in costly shutdowns for repair. Surveys show that leaks have affected one half of all water-cooled reactors in the world with steam generators. CANDU reactors have demonstrated the highest reliability. However, AECL is actively evolving new technology in design, manufacture, inspection and operation to maintain reliability. (auth)

20266 SPHERICAL SAFETY VESSEL FOR NUCLEAR REACTORS. Ullrich, W.; Fassl, R.; Lohse, K. H.; Leuteritz, J.; Zeitzschel, G. (to Verwaltungs GmbH). German Patent 1,564,289. 5 Jul 1973. 3p. (In German).

A pressure suppression system in a spherical containment for nuclear reactors is described. In addition, the condensation chamber has been arranged in such a way that the vapour in every operational accident can be condensed. (GE)

20267 NUCLEAR REACTOR COOLED BY A LIQUID COOLANT. Grain, D. R. (to United Kingdom Atomic Energy Authority). German Patent 1,439,846. 15 Feb 1973. 4p. (In German).

The reactor described is characterized in that the coolant flow in the reactor core consists of a main flow and pressurizing flow, where the media are intended to bring the pressurizing flow to a higher temperature than the coolant main flow in the reactor core, as it travels through the reactor core. The tank designed pressurizing unit is described. (GE)

20268 ELEKTRICHESKOI CHASTI ATOMNYKH ELEKTROSTANTSII. (Characteristics of the Electrical Section of Atomic Power Plants). Fel'dman, M. L.; Chernovets, A. K. Leningrad; Energiya (1972). 168p.

The basic characteristics and the differences of the electrical section of nuclear power plants in comparison with the electrical section of thermal power plants with organic fuels are discussed. The characteristics of the flow sheet of promising types of nuclear power plants are given. There is an examination of the most important mechanisms for the house supply and its electric drives. On the basis of the examination of the characteristics of the operating regimes, particularly emergency cooling, the requirements on the reliability of the electrical power for the house power are formulated and those means taken to satisfy the reliability requirements are indicated. The characteristics of the primary electrical circuits of the nuclear power plant are examined and the characteristics of this part of the plant in covering the grid load of the energy system are analyzed. (tr-auth)

20269 NUCLEAR REACTOR CORE. Bevilacqua, F. (to Combustion Engineering, Inc.). German Patent 2,302,750. 26 Jul 1973. 15p. (In German).

The reactor core described consists of groups of vertical standing fuel rods and is reinforced between the end plates of the groups by grids, which are composed of criss-cross bars. To improve the removal of heat, coiled baffles are put on the bar crosspoints. The baffles stretch in spiral form upwards and/or downwards into a flow channel of the coolant up to its free end. Coils and baffles are individually described. (GE)

20270 ANALYSIS AND DESIGN OF HYPERBOLIC COOLING TOWERS. Gurfinkel, G.; Walser, A. J. Power Div., Amer. Soc. Civil Eng.; 98: No. 1, 133-152(Jun 1972).

An analysis and design of a specific hyperbolic cooling tower for a nuclear power plant are presented. The effect on design of variations in wind distributions, earthquake forces, and base restraints are considered. The results are obtained by employing the available finite-element programs and are used to design the reinforcement for the shell. It is shown that a substantial variation in meridional forces occurs due to the consideration of various wind distributions. This suggests that Belgian rough wind distributions, which yield lower values, should be used only after careful substantiation. The overturning moments at the tower base are computed and yield a minimum factor of safety of 11, indicating that overturning in hyperbolic cooling towers is not of special concern. Earthquake analysis using 2 percent damping and an earthquake spectra for a maximum ground acceleration of 5 percent of gravity are carried out. The meridional forces caused by earthquake are one-fourth of those due to ASCE-type wind and are not critical for hyperbolic shells used in cooling towers. The assumption of a fixed constraint at the base of a cooling tower, instead of the actual column supported base, does not affect the meridional forces due to self-weight to any appreciable degree. On the other hand, hoop forces at the base due to wind loads for actual column-supported base are much larger than for a fixed base and must be taken into account. The design for meridional and hoop reinforcement for shell is carried out and its orientation discussed, based upon the principal stress direction. (App. Mech. Rev.)

20271 DATA ANALYSIS DURING CONTAINMENT LEAK RATE TEST. Lau, L. W. Power Eng.; 78: No. 2, 46-49(Feb 1974).

On-line analysis of containment leak rate data is essential to determine the leakage rate so that the flow rate of the required verification test can be set properly and to statistically determine the adequacy of the data being developed. A practical guide for handling the test data on-line with a hand calculator is given and a glossary of terms is provided. Some of the terms apply to the leak rate test and the others apply to the data analysis. (FS)

20272 MODERATOR CONTAINER FOR PRESSURE TUBE REACTORS. Borchardt, D.; Dorner, H. (to Siemens AG). German Patent 1,813,360. 8 Feb 1973. 2p. (In German).

The moderator container consists of a cylindrical part with an upper and lower lid made of a grid of parallel and upright arranged steel girders. Fitted cover boxes in the grid meshes are gripped by sockets. On the upper and lower side of one of each lid a liquid leakproof seal has been made by welding on a sheet of metal. (GE)

20273 GASKET FOR PENETRATION OF A NUCLEAR REACTOR PRESSURE VESSEL. Bell, F. R.; Arthur, I. P. (to Gulf Oil Corp.). German Patent 1,589,845. 18 Jan 1973. 3p. (In German).

A gasket is described to be used where the space formed between the inner and outer seal exerts a pressure which is greater than the pressure in the pressure vessel. The space to let in the cooling medium under pressure, purified by radioactive particles, has been designed with flow control equipment. An outer seal, consisting of two gasket elements separated by a space, is connected to a leak control apparatus. (GE)

20274 HYDRAULIC LOOSENING OF SCREWS OF REACTOR VESSEL HEADS. Fabry, C. W. (Maschinenfabrik AG, Esslingen, Ger.). Konstr. Masch.-, App.- Geraetebau; 25: No. 7, 263-266 (1973). (In German).

During the successive tightening of the screws, the stress applied will always reach the nominal initial stress values, although this stress on the screws will be reduced again to a certain extent due to the repeated displacement of the tightening device. During the successive loosening of the screws, the initial stressing force on the remaining groups of screws still to be loosened will constantly increase. This increase in stressing force might exceed the capacity of the tightening (or loosening) devices. In this case it is advisable to loosen the screws only to a certain extent and

thus reduce the initial stressing forces to about two thirds or half. A diagram is given showing the percentage increase for a given number of groups of screws to be loosened. Thus the optimum number of tightening (or loosening) devices can be determined at the design stage. (GE)

20275 COMPUTER-AIDED DESIGN AND OPTIMIZATION OF HEAT EXCHANGERS. Schnauder, H. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 15: No. 11, 493-499 (Nov 1973). (In German and English).

The advantages and possibilities offered by EDP facilities in the field of engineering design are illustrated by the example of a sodium/sodium intermediate heat exchanger. The program system discussed is capable of designing the heat exchanger for steady state operating conditions. The usual thermal design is followed by mechanical strength design calculations. Besides the usual print output a plot output is also possible, consisting of diagrams and simple cross-sectional drawings to scale. (GE)

20276 POSSIBLE FAILURE MODES OF VALVES AND OF THEIR CONTROL ELEMENTS WITH PARTICULAR REFERENCE TO REACTOR PROTECTION. Hoertner, H. (Technische Univ., Munich). Kerntechnik; 15: No. 11, 508-513(Nov 1973). (In German and English).

A survey is presented of possible failure modes of hydraulic valves. Failure rates for control failures are shown. It is shown how to deal with the possible failure modes of valves in fault tree analyses. The investigations are based on Simatic-P control systems, especially as used for reactor protection in nuclear power plants. (GE)

20277 ROTORK ACTUATORS FOR AUTOMATION IN POWER STATIONS. Klotzbach, K. H. BBC-Nachr.; 55: No. 8-9, 191-196(1973). (In German).

Rising energy requirements necessitate further simplification of work in power station design. Devices which may be automated include: slide valves, valves, ball valves, and butterfly valves. These may all be operated by Rotork actuators, which are robust, compact devices, designed to operate reliably under difficult conditions in power stations. (GE)

20278 CORROSION PROBLEMS IN STEAM CONDENSERS OF THERMAL AND NUCLEAR POWER PLANTS. I. Bianchi, G. A.; Cerquetti, A.; Longhi, P.; Mazza, F.; Torchio, S. (Univ., Milan). Atti Notiz. (Publ. in Met. Ital.); 28: No. 9, 515-527 (Sep 1973). (In Italian).

The technical-economic aspects of corrosion problems in steam condensers are briefly considered. The general framework of the corrosion problem is outlined with a consideration of the corrosion conditions and the corrosion of structural materials. Factors which affect the metal of the tube such as chemical composition, mechanical characteristics, surface state, and protective films are discussed. Factors affecting the coolant water are then considered. Factors affecting the thermal exchange are described. (JSR)

20279 CORROSION PROBLEMS IN STEAM CONDENSERS OF THERMAL AND NUCLEAR POWER PLANTS. II. Bianchi, G. A.; Cerquetti, A.; Longhi, P.; Mazza, F.; Torchio, S. (Univ., Milan). Atti Notiz. (Publ. in Met. Ital.); 28: No. 10, 588-602(Oct 1973). (In Italian).

The fundamental processes in the corrosion of Cu and its alloys in natural water are outlined. Protective films formed in solution and porous and compact coatings are discussed. (JSR)

20280 PRESTRESSED CONCRETE PRESSURE VESSELS FOR NUCLEAR REACTORS. A Standard for the Future. Cochrane, H. B. (Central Electricity Generating Board, London). BSI News; 14-15(Sep 1973).

The Chairman of the British Standards Institution reorganised Pressure Vessel Industry Standards Committee here presents an analysis of the recently published BS 4975, Prestressed Concrete Pressure Vessels for Nuclear Reactors. (UK)

Reactor Fuels

Refer also to abstracts 18333, 18780, 18782, 18784, 18787, 18791, 18793–18807, 18809, 18984, 18985, and 19000.

20281 (CEA-CONF-2323) TESTS UNDER ABNORMAL OPERATING CONDITIONS. Desandre, C.; Gouirand, J. M.; Marin, F. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). 7 May 1973. 18p. (In French). (CONF-730573-2). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of the Euratom working group on irradiation devices; Saclay, France (24 May 1973).

The test reactor Pegase possesses a number of independently operating loops (having different characteristics) which, when used in conjunction with the appropriate irradiation facility, enable tests to be performed on fuel elements of various types of reactors. Particularly interesting are applications in determining limiting conditions, and studying safety margins and operation under abnormal conditions. Tests effected on fuels for graphite-gas, HTR, and fast neutron reactors are presented. (auth)

20282 (EURFNR-1107) ASSESSMENT OF COMPATIBILITY OF OXIDE FUEL PINS. Goetzmann, O.; Hofmann, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. Fuer Material- und Festkoerperforschung). May 1973. 34p. Dep. NTIS $3.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The compatibility behavior of oxide fuel pins is described using results given in the literature. Possible factors, such as degree of burnup, inner wall temperature, fuel O/M-ratio, impurities in the fuel, and others which may have an influence on the compatibility behavior are described, and an assessment of their effect is given on the basis of observations. The following conclusions can be drawn: Mainly responsible for the cladding attack is the inner wall temperature and the oxygen potential in the pin. Reactions with the cladding occur at temperatures beginning at 500°C. In the temperature range between 600 and 700°C penetration depths of normally 100 to 120 μm are reached. In some cases, penetrations of 200 μm can be observed. These attacks can be seen after burnup of around 5 at.%. After higher burnups, (16 at.%), cladding attack has not propagated much. Lowering of the fuel O/M-ratio reduces cladding attack. Fuel density has no influence on the compatibility behavior. Impurities of carbon, nitrogen, and moisture have no influence on fuel-cladding reactions if they are kept at contents around 100 ppM. (auth)

20283 (LA-5480-MS) FUELPIN: A DATA RETRIEVAL SYSTEM FOR NUCLEAR FUEL PIN INFORMATION. Walters, K. L.; Barner, J. O.; Green, J. L. (Los Alamos Scientific Lab., N. Mex (USA)). Jan 1974. Contract W-7405-eng-36. 33p. Dep. NTIS $4.00.

The Fortran IV computer code FUELPIN was developed to assist in the surveillance of large numbers of nuclear fuel pins. Using sixteen levels of sorting and thirty-one key pin characteristics, the computer code sorts through large blocks of pin data to determine those pins having the desired characteristics. Allowance is also made for miscellaneous information on (1) fuel type, (2) clad material, (3) bond data, and (4) general pin information. Upon execution the blocks of fuel pin information are inspected to insure that the data are credible, i.e., between experimenter specified limits. Octal stops are provided, numbered, and discussed in the codes comment section so as to block all paths of code execution known to indicate operational error. All parameter sort information is also inspected for potential input error with some minor correctional measures accomplished upon detection of an error condition. Though limited to blocks of two hundred and fifty pins per run, large numbers of pins may be efficiently examined through problem stacking and proper use of a built in computer time economizing scheme. (auth)

20284 URANIUM. The Power Demand. Metal Bull. Mon.; No. 35, 16-21(Nov 1973).

Energy consumption and nuclear capacity in the next decade are forecast. Features of the main reactor types are briefly described and the future supply and demand of uranium is examined. Some current problems in the USA which are causing delays in the light water reactor program are also discussed. (UK)

20285 FUEL ELEMENT BUNDLE FOR A THERMAL REACTOR. Crowther, R. L. (to General Electric Co.). German Patent 1,814,641. 12 Apr 1973. 3p. (In German).

In the fuel element bundles described, the groups of fuel elements contain differing amounts of fissionable uranium and plutonium. The groups are concentrically arranged, where the plutonium content increases from the outer group towards the inner one. (GE)

20286 NUCLEAR REACTOR FUEL ROD. Busch, H. (to Kernreaktorteile GmbH). German Patent 2,128,911. Jan 1973. 7p. (In German).

The fuel rod is characterized in that, a heat insulator in the form of a plate on a conical extension of the end cap has been designed, to go between the end cap and plenum spring which serves as a space for the formation of a fission gas. (GE)

20287 MANUFACTURE OF FUEL FOR NUCLEAR REACTORS. Hrovat, M. F.; Gough, J. R. C.; Price, M. S. T. (to United Kingdom Atomic Energy Authority). British Patent 1,327,786. 22 Aug 1973. Filed Date 13 Nov 1970. 4p.

A method is described for making pressed compacts of nuclear fuel. A die cavity is loaded with a mixture of coated fuel particles, polymerizable resin, and granular matrix material such as graphite, and heated so that an even temperature exists throughout the contents. The temperature should be such that the resin melts but does not suffer a change in structure and together with the matrix material shows a uniform plasticity. The die contents are then pressed, at temperature, so that they are compacted throughout the cavity. The resin may be of phenol-formaldehyde type, with a low ortho content. A hardener may be incorporated in the mixture in a proportion that does not cause premature polymerization. The mixture may be charged into a die block having a number of cavities, closing the cavities and heating the block slowly and uniformly in an oven to about 150°C. The heated die block may then be placed between the thermally insulated platens of a press and the latter then operated to press the contents of all the die cavities simultaneously, and after pressing the die cavities may be maintained closed while the block is further heated to cure the resin. (UK)

20288 NUCLEAR FUEL. Sturge, D. W. J.; Davies, T. A. (to United Kingdom Atomic Energy Authority). British Patent 1,331,573. 26 Sep 1973. Filed Date 28 Apr 1971. 3p.

A process is described for the application of deformable overcoatings of nuclear fuel particles that already have fission product retaining coatings. It consists of tumbling batches of the particles on a moving surface while grains of dry powdered overcoating material, including a binder, are introduced on to the particles, while simultaneously applying a film of binder solvent. A rotating drum may be used for the process, having its axis inclined to the horizontal. (UK).

Reactor Control Systems

20289 (AEC-tr-7516) DEVELOPMENT AND STUDY OF DEVICES FOR DETERMINING POWER PEAKS IN A CORE WITH STATIONARY FLUX-MEASUREMENT PROBES. Klar, E.; Seidelberger, H.; Bauer, H. (Siemens A. G.; Erlangen (F. R. Germany). Abt. Reaktortechnik). Apr 1973. Translation of BMFT-FBK-73-07. 17p. Dep NTIS $3.00.

In large pressurized water reactors flux detectors are built into the core for the purpose of evaluating the flux distribution and measuring local flux peaks. The following investigations were made: mechanical parts of multi-finger assemblies, and gamma thermometers, gamma chambers, miniature fission chambers, and n-β-detectors. The most appropriate are n-β-detectors. In the future, preference is to be given to n-β-detectors, using the aeroball system for determining the power density distribution and calibrating the core detectors. (auth)

20290 (CWR-475(Del.)) PLUTO PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 12, 1957. (Curtiss-Wright Corp., Quehanna, Pa. (USA). Research Div.). 1957. Contract AT(30-3)-220. 86p. Dep. NTIS $6.50.

Declassified 27 Nov 1973.

Information is presented concerning reactor kinetics, fabrication and testing of ceramic materials, and design of reactor control rods. (DCC)

20291 (GEAP-13824-7) LMFBR ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT AND TESTING. Seventh Quarterly Report, July–September 1973. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Oct 1973. Contract AT(04-3)-893. 42p. AT.

Design of the Alternate Shutdown System (ALSS) was continued, and the first phase of the damper test was completed. Design arrangement studies were performed and interface requirements were specified to facilitate integration of the ALSS into the Demonstration Plant. Analytical work was conducted in the areas of dynamic modeling, reliability and structural evaluation. (4 references) (auth)

20292 (GULF-GA-A-10812) ANALYSIS OF THE EFFECTS OF FORT ST. VRAIN PLANT PROTECTIVE CONTROL AND INSTRUMENTATION ON PLANT AVAILABILITY. Stokely, R. J.; Forutanpour, B.; Corte, E. (Gulf General Atomic Co., San Diego, Calif. (USA)). 28 Apr 1972. Contract AT(04-3)-633. 148p. Dep. NTIS $9.50.

An analysis of the effects of the Fort St. Vrain Plant Protective Control & Instrumentation (PPC&I) System on the plant availability is presented. It is concerned with the expected number of plant shutdowns due to spurious signals from the PPC&I System. The model is formulated by working from the terminal event of interest (i.e., shutdown) back through the circuitry to the sensors. All maintenance times are assumed to be log-normal. The results are presented using the expected values of failure rate and maintenance times along with the results obtained if failure rates and/or maintenance times are all increased by the same respective factors. The method can be employed to analyze similar systems where an analysis of the effects of spurious signals is required. (5 references) (auth)

20293 (UCRL-6833-T(Summ.)) NEUTRONIC DESIGN OF TORY II-C CONTROL ROD SYSTEM. Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Mar 1962. Contract W-7405-eng-48. 6p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

20294 (UCRL-6834-T(Summ.)) NUCLEAR HEATING OF TORY II-C HAFNIUM CONTROL RODS. Kellman, S.; Lorenz, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Mar 1962. 7p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

A nuclear heating analysis of the control rod assembly within the TORY II-C core was made to determine its power density at full power conditions. The use of hafnium as control poison and the selection of an asterisk rod geometry made a detailed study of the (n,γ) heating necessary. Because of the complexity of the heating process, a gamma-ray Monte Carlo code was developed for use in this analysis. (auth)

20295 (UCRL-7187) PLUTO QUARTERLY REPORT NO. 14, OCTOBER–DECEMBER 1962. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jan 1963. Contract W-7405-eng-48. 209p. Dep. NTIS $12.50.

Declassified 27 Nov 1973.

Information is presented concerning Tory-2C neutronics, thermodynamics, control system, and materials testing. (DCC)

20296 (UCRL-12086) DESIGN REPORT: TORY IIC CONTROL SYSTEMS. Day, J. A. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1965. Contract W-7405-eng-48. 515p. Dep. NTIS $27.75.

Declassified 27 Nov 1973.

20297 (UCRL-12279) 1200°F NUCLEAR-TOLERANT ELECTROPNEUMATIC ACTUATOR FOR PROJECT PLUTO. Day, J. A.; Wright, G. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Mar 1965. Contract W-7405-eng-48. 44p. Dep. NTIS $4.25.

Declassified 27 Nov 1973.

The 1200°F pneumatic actuator subsystem and its specification is described briefly, as it relates to the Tory IIC nuclear ramjet test vehicle, and the actuator configuration and design are discussed in general terms. Developmental problems and their corresponding solutions are described. Wiring details, seal details, material fabrication and processing techniques, and high-temperature lubrication application techniques are presented. Actuator performance and its improvement is discussed. Valve and motor combination development, design, and performance information is presented, with stress on the analog model and solutions arrived at. Actuator life test, performance, and final operational data are given. It is demonstrated that the "state of the art" in high temperature control systems has been advanced to the point where 10 to 30 hr operation of components at 1200°F can be attained in the performance realm of 5 to 10 cycle response at 90° phase lag, and at output power levels of 250 to 300 in./lb stall torque and 13,000 lb/in. stiffness. 4 references. (auth)

20298 EXPRESSION FOR THE REACTIVITY WORTH OF A NUMBER OF SMALL CYLINDRICAL BLACK CONTROL ELEMENTS ARRANGED AS A CLOSELY SPACED RING. Balakrishnan, K. J. Nucl. Energy; 27: No. 12, 888-890(Dec 1973).

The reactivity worth of a small ring of control rods so closely spaced that they are touching may be determined by the Nordheim Scalettar method if it is assumed that the ring is replaced by a moderator filled cyclindrical annulus which is black to thermal neutrons and transparent to fast ones, and whose inner and outer surfaces are tangential to the inner and outer surfaces of the individual control rods. A correction is derived which may be applied to this value to give the reactivity worth in a situation where the rods are not contiguous. (UK)

20299 METHOD FOR THE CONTROL OF A BOILING WATER REACTOR AND A BOILING WATER REACTOR FOR PERFORMING SAID METHOD. Rolstad, E.; Jamne, E. (to Institutt for Atomenergi). US Patent 3,766,007. 16 Oct 1973. Filed date 31 May 1970. 10p.

The invention relates to the control of a boiling water reactor in which the water circulates by natural convection in the reactor tank through the core, a riser above the core and a downcomer. By varying the water level in the downcomer, the flow rate of

circulation and thereby the void fraction in the core and the reactivity are changed. The water level in the downcomer may be adjusted by transferring water to or from an auxiliary reservoir. The local circulation flow rate may be influenced by having a graded riser and by the use of nozzles. (Official Gazette)

20300 IAEA INTERNATIONAL SYMPOSIUMS ON NUCLEAR POWER-PLANT CONTROL AND INSTRUMENTATION. Hagen, E. W.; Kerlin, T. W. Nucl. Safety; 15: No. 1, 15-29(1974).

In recognition of the significant advances being made in the field of nuclear power-plant control and instrumentation, the International Atomic Energy Agency organized a series of biannual symposiums on the subject. These meetings provided specialists from the member states with an opportunity for a comprehensive exchange of information on the current international status of this important field. The discourse from the first meeting (Vienna, 1969) is summarized, the proceedings from the second meeting (Vienna, 1971) are reviewed, and some of the presentations made at the third meeting (Prague, 1973) are discussed. (auth)

20301 NUCLEAR MEASURING TECHNIQUES. In-Core Measurement Methods. Endler, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 4, 93-96 (Apr 1973). (In German).

A review of the development of in-core measurement methods is presented. After having characterized the meaning of in-core instrumentation and of the individual quantities to be measured the progress achieved and the prospects of the detectors used are discussed. The problems of signal transfer and processing are briefly treated. (auth)

20302 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Robinson, C.; Vaughan, H. J. (to Nuclear Power Group Ltd.). British Patent 1,333,703. 17 Oct 1973. Filed Date 29 Aug 1969. 6p.

A system is described for monitoring the voltage outputs of thermocouples located in the fuel channels of a nuclear reactor. Means are provided for scanning the outputs of groups of thermocouples and detecting the outputs from the channels having the highest temperature, that output, or a signal representative of it, being coupled alone to a circuit or circuits common to the group of thermocouples, with means to initiate the operation of protection equipment. The output voltages of the group of thermocouples are continuously compared with a reference voltage that varies between predetermined values in a repetitive manner whereby the channel having the highest temperature is identified in each cycle of the reference voltage. (UK)

20303 RELIABILITY OF PROCESS COMPUTER SYSTEMS FOR THE PROTECTION OF NUCLEAR POWER PLANTS. Renk, K. D. (Technischer Ueberwachungs-Verein Norddeutschland eV, Hamburg). Tech. Ueberwach.; 14: No. 12, 350-353(Dec 1973). (In German).

It is shown that the extreme reliability requirements in nuclear technology call for the development of special hardware and software methods in order to allow the use of process control computers in nuclear plant protection. Currently available concepts and their reliability are reviewed and further trends are discussed. It seems that the great variety of these studies (reference 15 alone cites 714 references from the Russian literature) will soon lead to the definition of clear concepts that promise the use of process control computers in nuclear plant protection. (GE)

20304 INITIAL OPERATING RESULTS OF CLOSED-LOOP CONTROL OF UNIT OUTPUT AT WUERGASSEN NUCLEAR POWER STATION. Beckmann, H. (Kraftwerk Union AG, Frankfurt am Main); Maygatt, W. VGB Kraftwerkstechnik; 53: No. 10, 646-650(Oct 1973). (In German).

The Wuergassen nuclear power station must be capable of responding to primary and secondary closed-loop control in the interconnected grid system. This imposes certain requirements on the closed-loop control of unit output. On the basis of initial results it may be expected that the power station unit will demonstrate good control characteristics in the tests on the control performance still being undertaken over the full range of output. (GE)

20305 KS-150 REACTOR CONTROL. Wagner, K. Skoda Rev.; No. 4, 19-25(1973).

The reactor control and protection systems for the Bohunice A-1 reactor are described. The testing of the systems is reviewed and the systems' performance during the initial reactor startup is discussed. (JWR)

20306 ELECTRICAL EQUIPMENT OF THE MUEHLEBERG ATOMIC POWER STATION. Marti, K. Polytech. Tijdschr., Elektrotech./Electron.; 28: No. 7, 205-214(4 Apr 1973). (In Dutch).

A complete station layout is presented showing location of all electrical installations: turbogenerators, transformers, switchgear, etc. Additional diagrams show details of switchboard connections. An account is also included of the computer-linked control/protection system for the (BWR) nuclear reactor. (INIS)

20307 NUCLEAR REACTOR CONTROL ELEMENT DRIVE. Maslenok, B. A.; Zlobin, V. G.; Khegai, A. S.; Nikolaev, V. P.; Kryuger, E. A. British Patent 1,328,937. 5 Sep 1973. Filed Date 20 Apr 1972. 3p.

The drive described is of rack and pinion type, with an electromagnet for engaging and disengaging the rack and pinion, the electromagnet being arranged coaxially with the axis of the rack. The pinion is driven by an electric motor through speed reducing gearing. A swinging balance arm carries the pinion, one end of this arm being mounted on a gearing shaft, and the arm being connected to the core of the electromagnet so that it can be caused to swing to engage or disengage the rack and pinion. Connection of the arm to the core is by means of at least one articulated rod set at an acute angle to the axis of the rack. This arrangement simplifies the design of the drive, reduces its lateral dimensions, and reduces the time elapsing from receipt of a signal for movement of the element in the reactor and the beginning of its movement, both under normal operation and emergency conditions. Servicing is simple and capital cost is reduced. (UK)

20308 IMPROVEMENTS RELATING TO NUCLEAR REACTOR CONTROL RODS. Sanders, J. (to John Thompson (Pipework and Ordnance Division) Ltd.). British Patent 1,328,997. 5 Sep 1973. Filed Date 17 Nov 1970. 5p.

Reference is made to control rods that are lowered into a reactor from above by means of chains. It is customary to form these control rods by a number of articulately connected sections so as to allow for any slight misalignments of rods or their channels due to the high temperature and radiation environment. The type of connection previously employed consists of a headed pin on one section which is captively received within a bush on the adjacent section, the dimensions of the headed pin and bush being such as to allow for limited angular misalignment of adjacent sections. This arrangement has the disadvantage of frictional contact. It is also customary to incorporate in such control rods some form of shock absorber to cushion the impact if the rod is accidentally, or deliberately, allowed to fall into the reactor; this type of shock absorbing device is not entirely satisfactory and is expensive to produce. In the improved control rod described adjacent articulated sections are connected together by means of spring members rigidly connected to each section. Full constructional details are given. (UK)

Nuclear Power Plant Economics

Refer also to abstracts 20454, 20467, 20482–20484, and 20499.

20309 (CONF-731130-1) POWER SYSTEM SIMULATION AND OPTIMIZATION MODELS FOR PLANNING NUCLEAR REFUELING CYCLES. Turnage, J. C.; Bennett, L. L.; Joy, D. S.; Prince, B. E. (Oak Ridge National Lab., Tenn. (USA)). 1 Oct 1973. 45p. Dep. NTIS $4.25.

From Operation Research Society of America; San Diego, California, USA (12 Nov 1973).

The mid-range system being modeled may include a mix of fossil, nuclear, hydro, pumped-storage, and peaking units. For any predetermined nuclear refueling schedule, the program (ORSIM) determines an approximately optical plan of operation for the system. This includes the determination of a maintenance schedule for the non-nuclear units and a schedule of energy delivery for each plant in the system. The criterion of optimality is the minimization of the total discounted operating cost of the system over the specified study period. Over this period, the model computes the expected station load factors, the loss of load probability and unserved energy for the system, and the production costs of operating so as to meet the forecasted loads on the system. The code takes account of variations and growth in demand over the planning horizon, occurrence of unit forced outages, planned shutdowns for nuclear refuelings, maintenance scheduling, allocations of fixed hydro and nuclear energies, and interactions between nuclear unit reloadings and fuel costs. 13 references. (auth)

20310 (ORNL-TM-4443) COLLECTION OF PAPERS PRESENTED AT THE NUCLEAR UTILITIES PLANNING METHODS SYMPOSIUM, CHATTANOOGA, TENNESSEE, JANUARY 16–18, 1974. Turnage, J. C.; Prince, B. E. (comps.). (Oak Ridge

National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 654p. (CONF-740102-). Dep. NTIS $34.75.

Separate abstracts are included for 27 of the 29 papers presented concerning mid-range optimization modeling, system integration, nuclear core simulation and optimization, system expansion modeling, and associated planning analysis techniques. Two of the papers have been previously abstracted and included in NSA. These papers may be located in the NSA Report Number Index under the following numbers: CONF-730414-P2 and CONF-730414-P1. (DCC)

For abstracts of individual papers see: 18131, 20005, 20021, 20250, 20311–20326, 20335–20340, and 20414.

20311 (ORNL-TM-4443, pp vp Paper 2) INTRODUCTION TO MID-RANGE SIMULATION AND OPTIMIZATION. Koncel, E. F. (Commonwealth Edison Co., Chicago). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

When the Systems Analysis Joint Study Group was faced with the challenge of studying and developing tools to optimally integrate nuclear generating units into existing and future utility generating systems, it divided the problem into three time frames: namely, long range, mid-range, and short range. The mid-range was defined as a period of time extending five to ten years into the future. The mid-range problem was defined as one of operational planning; that is, the planning of the most practical and economical coordinated operation and fueling of nuclear and fossil units, consistent with the reserve requirements of the system and all operating and regulatory constraints. A review of the mid-range optimization of nuclear power plants is presented. (auth)

20312 (ORNL-TM-4443, pp vp Paper 3) PROBABILISTIC MODEL FOR ESTIMATING THE OPERATING COST OF AN ELECTRIC POWER GENERATING SYSTEM. Joy, D. S. (Oak Ridge National Lab., TN); Jenkins, R. T. Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The concept of using a probabilistic simulation for estimating the operating cost of generating plants within an electrical utility was first introduced in 1967, and has recently been gaining acceptance in the United States. Basically, the probabilistic simulation technique develops the cost of operating a utility system over an extended period of time by forecasting the power to be generated by each plant. The basic model for this technique requires the following information: system load duration curve, loading order of units, generating unit characteristics, and energy supplied by energy-limited units such as hydroelectric units. The major advantage of the technique is its capability for simulating the effects of random events such as unit forced-outages. The basic probabilistic simulation model and modifications that have been made to represent more effectively the operation of large thermal units during low load periods and to take into consideration the effect of hydroelectric and pumped-storage units are presented. The model is versatile and can be modified easily. Computation times have averaged between 0.001 and 0.01 sec/unit on an IBM 360/91 computer with a memory requirement of approximately 80 K bytes. The probabilistic simulation model is used as a subroutine for estimating operating costs in conjunction with optimization techniques for studying utility planning problems. (6 references) (auth)

20313 (ORNL-TM-4443, pp vp Paper 5) COMPUTER CODE FOR THE SIMULATION AND OPTIMIZATION OF UTILITY SYSTEM OPERATION WITH NUCLEAR PLANTS. Turnage, J. C.; Prince, B. E. (Oak Ridge National Lab., TN). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The work described in this paper is concerned with the mid-range (5–8 year) operation of electric power generation systems. In particular, it is concerned with utilizing system simulation and optimization techniques to assist in nuclear and fossil plant generation planning. To approach the issues appropriate to mid-range utility operation, a computer model (ORSIM) has been developed as part of a cooperative effort between the AEC, TVA, and Commonwealth Edison Company. For any predetermined nuclear refueling schedule, the ORSIM model determines an approximately optimal plan of operation for systems which may contain fossil, nuclear, hydro, and pumped-storage units. This includes the determination of a maintenance schedule for the non-nuclear units and a schedule of energy delivery for each plant in the system. The criterion of optimality is the minimization of the total discounted operating cost of the system over the specified study period. Over each subinterval of this period, the model computes the expected station load factors, the loss of load probability and unserved energy for the system, and the production costs of operating so as to meet the forecasted system loads. The code takes account of variations and growth in demand over the planning horizon, occurrences of unit forced outages, planned shutdowns for nuclear refuelings, maintenance scheduling, allocations of fixed hydro and nuclear energies, and interactions between nuclear unit reloadings and fuel costs. (13 references) (auth)

20314 (ORNL-TM-4443, pp vp Paper 6) COORDINATION OF NUCLEAR UNIT REFUELING WITH SYSTEM OPERATION. Bukovski, J. (Commonwealth Edison Co., Chicago). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The initial phase of the mid-range System Optimization scheme is a model that determines feasible nuclear refueling schedules within system constraints over the planning horizon. The model yields feasible refueling schedules in an order that gives priority to those which maximize the amount of nuclear capacity on the system during each discrete time period in the analysis. The model has been computerized by Commonwealth Edison and the program is called REFUEL. Once REFUEL has determined the feasible nuclear refueling schedules over the planning horizon, the mid-range Optimization scheme will then develop the system costs associated with those selected for further analysis. (auth)

20315 (ORNL-TM-4443, pp vp Paper 7) APPLICATIONS OF A SIMULATION MODEL (ORSIM) TO ELECTRIC GENERATION PLANNING. Farrar, D. L. (Commonwealth Edison Co., Chicago). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

For several years, the Joint Systems Analysis Study Group has been developing planning methods for integrating nuclear fuel management decision-making procedures into a global framework of total generating system optimization. The planning objective has been to determine, over a suitable period, the approximately optimal operating strategy which achieves minimum system generation costs while maintaining an acceptable system reliability. The power and flexibility of a simulation model as an aid to utility managers facing intertemporal, multi-faceted problems are demonstrated. In particular, the simulation model used is the ORSIM computer code developed at Oak Ridge National Laboratory. The iterative approach for which ORSIM was designed is shown. Variations of this approach exist. (15 references) (auth)

20316 (ORNL-TM-4443, pp vp Paper 8) UTILITY SYSTEM INTEGRATION AND OPTIMIZATION MODELS FOR NUCLEAR POWER MANAGEMENT. Deaton, P. F. (Westinghouse Electric Corp., Pittsburgh). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

A nuclear power management model suitable for nuclear utility systems optimization has been developed for use in multi-reactor fuel management planning over periods of up to ten years. The overall utility planning model consists of four sub-models: (1) Refueling and Maintenance Model (RAMM), (2) System Integration Model (SIM), (3) System Optimization Model (SOM), and (4) CORe Simulation and Optimization Models (CORSOM's). The SIM and SOM sub-models are discussed and full-scale computerized versions of each (SYSINT and SYSOPT, respectively) have been evaluated. The SYSINT model is shown to be remarkably fast, performing the Booth-Baleriaux probabilistic utility simulation for a single time period on a system with over 45 generating units in less than 2.5 seconds on an IBM-370 model 155 computer. SYSOPT converged to optimum solutions in roughly ten iterations (1.5 minutes). Immediate reduction of iterations by roughly half is estimated by merely increasing piecewise-linearization of the network objective function. Overall model computational requirements are limited by available CORSOM's, which require 99% of the computational effort (over 3 minutes per reactor per SOM iteration). Nuclear incremental costs (~0.8–1.6 $/MWH) are less than fossil incremental costs (> 2.0 $/MWH) for the foreseeable future. Thus, nuclear power should always be operated so as to supply customer demands with a minimum use of the more expensive fossil energy. For the same reason, the lengthening of nuclear irradiation cycles (in terms of both energy and time) more

than pays for itself by reducing the total cost of fossil replacement energy. Idealized nuclear production schedules yield constant nuclear incremental costs regardless of reactor unit and time. One of the key input parameters is the fossil thermal energy cost. (20 references) (auth)

20317 (ORNL-TM-4443, pp vp Paper 9) SCHEDULING OPTIMAL SYSTEM OPERATION USING MIXED INTEGER PROGRAMMING. Kazemersky, P. M. (Tennessee Valley Authority, Chattanooga). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The mid-range problem of scheduling optimal system operation may be conceptually viewed as being composed of two subdivisions. For the first subdivision, a model was developed which deals with the allocation of energy and/or refueling dates to units on the system for a desired time period (planning horizon). Mixed integer programming is used as the technique of minimization in this model. The second subdivision encompasses the modeling of a nuclear power reactor core. This is a necessary component since its output is used in conjunction with a nuclear fuel economics calculation to determine nuclear fuel costs. An algorithm, NECTARS, was developed for this purpose. NECTARS is a modified and implemented version of PODECKA. The two subdivisions which comprise the model form a closed-loop scheme which seeks the minimization of total system operating cost (operation, maintenance and fuel cost) for the planning horizon. The closed-loop scheme that the two subdivisions use for determining the optimal system operating strategy functions in the following manner. An initial set of cost coefficients is provided to the system model (MIP) which selects an optimal energy and refueling policy. The results of this policy are made available to the nuclear model. This nuclear model determines a new set of cost coefficients based on this updated information. The cost coefficients of the MIP are revised to the new values just determined. At this juncture, the MIP is executed again to obtain a new optimal strategy based on the new cost coefficients. The new policy is passed to the nuclear model. The process of determining new cost coefficients and revising and executing the MIP continues. This loop is repeated until convergence to an optimal policy is reached. (6 references) (auth)

20318 (ORNL-TM-4443, pp vp Paper 10) OBTAINING OPTIMAL DISPATCH AND OUTAGE SCHEDULING STRATEGY AS A FUNCTION OF CURRENT TIME SYSTEM STATUS. Wicks, F. E. (General Electric Co., Schenectady, NY). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The technique that is required to obtain the optimal electric utility system dispatch and outage scheduling strategy depends upon whether any generating units are energy limited. A static type of analysis can be employed to obtain the optimal strategy at each point in time if the system has no energy limited generating units whereas a dynamic analysis must be performed over an operations planning time interval to obtain the optimal strategy if the system includes energy limited generating units. The development of the optimal strategy for each type of system is described. The techniques required to obtain the optimal strategy for systems with energy limited units are presented. (10 references) (auth)

20319 (ORNL-TM-4443, pp vp Paper 11) OPERATIONAL PLANNING OF MULTI-NUCLEAR UNIT SYSTEMS. Rhodes, J. T. (Virginia Electric and Power Co., Richmond). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

A model is presented that treats the long-term (multi-year) system-nuclear unit interaction aspects of the problem, assuming that the day-to-day operation of the system can be suppressed. In developing the model, the approach taken was to first divide the problem into three (coupled) component problems: system-wide energy allocation, in-core fuel management, and nuclear fuel cost determination. The model was then constructed to solve the first component problem, i.e., determining the energy allocation throughout the system that minimizes the total system fuel cost. It was assumed that the other two component problems could be solved separately and represented in the model solely by energy-dependent functions. This required that the nuclear unit refueling schedules and fuel batch parameters (batch sizes and enrichments) be known a priori. These functions were determined for a reference core design using simplified physics methods normalized to more exact calculations, and based on the linearity of these functions, linear programming was incorporated in the model as the optimization technique. To demonstrate the application of the model and to investigate some of the characteristics of multi-nuclear unit operational planning, a multi-year planning analysis was then performed for a hypothetical mixed power system. (6 references) (auth)

20320 (ORNL-TM-4443, pp vp Paper 12) OPERATIONAL SYSTEM PLANNING WITH NUCLEAR UNITS. Galloway, C. D.; Stoll, H. G. (General Electric Co., Schenectady, NY). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

Extended forced outages, slippage of unit installation dates, changes in interchange agreements, fuel price fluctuations, and fuel curtailments are examples of perturbations encountered by utility systems. These system perturbations accumulate over time causing the actual operating condition of the utility system to differ from the forecasted condition. If this difference is significant, a revised forecast must be prepared to evaluate the future operating requirements of the system. This is particularly true if some units or plants are operating with a fixed fuel supply. In the case of nuclear units, a fixed fuel supply may result from the lead time requirements for nuclear fuel processing. This energy constraint may have significant impact on production expense in the near term. In the intermediate and long term, nuclear fuel specifications should be re-evaluated in light of the most current knowledge of the utility system in order to achieve better system economy. Investigation of these operational planning problems requires simulation models of maintenance scheduling, production costing, nuclear fuel physics simulation, and production accounting. The digital computer program for integrating these models into a flexible tool for planning analysis is described. Following this, three important aspects of system simulation are discussed (1) probabilistic simulation of units with fuel consumption constraints, (2) system dispatching with nuclear units, and (3) computational implementation of extended operation planning. (7 references) (auth)

20321 (ORNL-TM-4443, pp vp Paper 22) REACTOR PERFORMANCE AND FUEL MANAGEMENT SIMULATOR FOR POWER SYSTEM PLANNING ACTIVITIES. Henderson, R. R. (Westinghouse Electric Corp., Pittsburgh). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The reactor performance and fuel management simulator described represents a compromise between the accuracy normally required for the nuclear calculations and the computational speed required by the simulator in its ultimate use as a computational module of a power system strategic optimization program. The concept on which the simulation is based is to make maximum use of the extensive data and results of more detailed calculations available for the typical nuclear unit operating on the power system. A one-dimensional state transformation model permits a rapid determination of BOL power distribution and EOL burnup distribution using empirical correlation parameters developed by fitting the results to more detailed calculational models. Empirical rules are developed to simulate both the external refueling decisions and the incore fuel management decisions for the unit. It must be noted that the purpose of the simulator is not to assist in making the decisions simulated but to simulate the results in considering the relative merits of various system operating and refueling schedules. (14 references) (auth)

20322 (ORNL-TM-4443, pp vp Paper 24) PERSPECTIVES ON THE DESIGN AND APPLICATION OF GENERATION PLANNING PROGRAMS. Marsh, W. D.; Moisan, R. W.; Murrell, T. C. (General Electric Co., Schenectady, NY). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

Generation planning is the process by which (1) the need for additional installed generation is established; and (2) the most economic choice of size and type of new generating units is made. It begins with a specification of future loads and ends with a definition of future generating units. It is distinguished from operations planning and fuel budgeting, although it shares with these functions basic probabilistic and simulation techniques. Generation planning studies are usually long-range—20 years or more—not because 20-year plans are desired but because the choice of the next generation addition needs to be examined and verified

over a period of time which is a major fraction of the unit's cost-producing life. (9 references) (auth)

20323 (ORNL-TM-4443, pp vp Paper 25) GENERATION EXPANSION PLANNING USING DIRECT OPTIMIZATION. Day, J. T. (Westinghouse Electric Corp., Pittsburgh). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The principal decisions confronting generation expansion planners involve the timing, type, and size of future generating unit installations. Even though the planner is primarily interested in decisions involving the next few plants, the long term economic effects of these near term decisions force the planner to develop a long range strategy (20-30 years) with which the near term decisions are hopefully compatible. The "goodness" of any such strategy is usually measured in terms of expected reliability in meeting forecast loads, and the total costs (capital and operating costs). Several obstacles have previously made the development of a direct optimization model impractical. One such obstacle is the inherent size of the problem if any useful degree of detail is retained, and another is its nonlinearity. Advances in optimization theory and the size and speed of computers have recently combined to make the development and use of such a model practical. The development considerations and use of a model which automatically develops an optimum generation expansion strategy are presented. (auth)

20324 (ORNL-TM-4443, pp vp Paper 26) ECONOMIC–ENVIRONMENTAL SYSTEM PLANNING. Schweppe, F. C.; Marks, D. H.; Farrar, D. L.; Gruhl, J.; Ruane, M. F.; Shiers, P. F.; Woodruff, F. Jr. (Massachusetts Inst. of Tech., Cambridge). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

Increased environmental concern and the "energy crisis" require the development of system planning techniques adapted to a complex decision-making situation involving many groups with different points of view. An overall approach to the generation expansion planning aspects of this problem is presented. Four components of this overall approach are: 1) "Generation Expansion Model; 2) "Site Evaluation: Air; " 3) "Site Evaluation: Water," and 4) "Production Cost Model." (26 references) (auth)

20325 (ORNL-TM-4443, pp vp Paper 27) WASP/SAGE: A MODULAR GENERATION EXPANSION MODEL UTILIZING DYNAMIC PROGRAMMING AND PROBABILISTIC PRODUCTION COSTING. Jenkins, R. T. (Tennessee Valley Authority, Chattanooga); Joy, D. S. Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The Wien Automatic System Planning Package (WASP) was specifically designed for the International Atomic Energy Agency's Market Survey for nuclear power in developing countries. The WASP package is composed of six programs which can be run independently or in series. The structure of the WASP package encourages a user-machine interface for monitoring intermediate results. The WASP package is designed to find the optimal expansion policy for a utility system. A dynamic programming algorithm is used in the optimizations. The major features of the WASP package are described. The WASP package is designed to run on relatively small computers. The maximum core memory required is 30,000 words or 120K bytes on an IBM 360 or 370 computer. The code uses magnetic disk files to save information from iteration to iteration thus avoiding the necessity of repeating calculations. (14 references) (auth)

20326 (ORNL-TM-4443, pp vp Paper 28) APPLICATION OF MODULAR OPTIMAL GENERATION EXPANSION MODEL. Joy, D. S. (Oak Ridge National Lab., TN). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The optimal utility generation expansion model was used by the International Atomic Energy Agency (IAEA) for their Market Survey for Nuclear Power in Developing Countries. At IAEA this package is called the Wien Automatic Systems Planning Package (WASP). The code evolved into its current modular form in order to analyze the various countries at the IAEA Computing Center in Vienna. During the IAEA Market Survey the optimization feature was not used extensively. In fact the WASP package was used as a cash flow program with the various expansion policies being input by hand. It became apparent that it would be extremely useful to modify the code to allow the user more flexibility in using the optimization program. During the past summer the following modifications were made to the WASP package. The reliability calculations were moved from the Merge and Simulation Program to the Expansion Configuration Generator Program. Hence, only reliable configurations are to be retained for further consideration. An option was also added to this program to limit the expansion configuration to those which just exceed a specified reliability criterion. Under this option, any configuration which represents an additional expansion over a reliable configuration would not be considered. This option significantly reduces the number of configurations to be simulated and simplifies the search for an optimum expansion policy. Once an optimum path has been found, the user can allow over installation to ascertain whether additional cost savings could be realized. A sample problem was formulated to test the usefulness of these modifications. (auth)

20327 PROMOTION OF REACTOR DEVELOPMENT IN 1973. Technol.-Nachr. Manage.-Inform.; No. 119, 8-9(1973).

A tabular survey is presented on the duration of the project, total costs and government supported shore for the promotion of reactor development as planned in the 1973 budget in the FRG. (GE)

20328 EUROPEAN INVESTMENT BANK: THREE LOANS FOR NUCLEAR POWER PLANTS. Ber. Inform. (Eur. Gemeinsch.); No. 22, 6-7(1973). (In German).

The up-to-present activities of the European Investment Bank are reported which is shared by the nine partner states of the European Community and whose aim is to financially promote the building of nuclear power plants. (GE)

20329 NUCLEAR POWER IN SPAIN. Casa, A. F.; Perilli, M. L.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 19: No. 10, 92-104(Oct 1973). (In Italian).

A review of the main nuclear activities in Spain and their organization is presented. Topics discussed include: nuclear power program; fuel cycle activities; and research activities. (22 references) (auth)

20330 TEXAS NUPLEX. Davison, R. R. (Texas A and M Univ., College Station). (1973). vp.

From 4th international symposium on fresh water from the sea and information report; Heidelberg, Ger. (9 Sep 1973).

The Texas A and M Nuplex Study involved fundamental research in intensified agriculture, direct contact heat transfer in sea water desalting, and an economic evaluation of various Nuplex sites in Texas. The results favored industrial locations; and deepwater port studies indicated a reorientation of the complex toward transportation plus nuclear energy and petroleum processing. (GE)

20331 JAPAN NUCLEAR ENGINEERING PROBLEMS. Vlasov, V. A. (comp.). At. Tekh. Rubezhom; No. 3, 3-6(1973). (In Russian).

The basic difficulties inhibiting the development of nuclear energy in Japan are examined. These include the almost complete absence of domestic nuclear fuels for the AEC, a rather large dependence on the delivery of foreign equipment for the AEC, and a shortage of land areas. The basic characteristics of the active and growing AEC of Japan are reported. The basic trends of the long-range development of nuclear energy are indicated. According to the new program of development of atomic energy, accepted in 1970, the AEC planned to construct by 1975 a total power of 9 million kW. In 2000 the AEC will produce 220.0 million kV of electroenergy which comprises 50% of all production of electrical energy in Japan. (tr-auth)

20332 CEA RESEARCH AND DEVELOPMENT IN THE FIELD OF NUCLEAR ELECTRICITY PRODUCTION. Brunin, S. V. Arch. Energiewirt.; 27: No. 21, 1075-1083(Nov 1973). (In German).

After a brief survey of the present state of development in the field of nuclear energy production in France (gas graphite–natural uranium reactors, enriched uranium fueled light-water reactors, fast breeders), as well as of planned projects (high-temperature reactors, reactors for direct energy conversion), the nuclear energy program of the Electricite de France is outlined. One of the main features of the recent development is the change-over to light-water reactors. (GE)

Reactor Fuel Cycle Economics

Refer also to abstracts 18131, 20020, 20021, 20092, and 20321.

20333 (INIS-mf-828) TESTING OF PLUTONIUM FUEL PERFORMANCES IN BR 3. Motte, F.; Basselier, J.; Vandenberg, C.; Vanhellemont, G. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Societe Belge pour l'Industrie Nucleaire, Brussels). 1973. 5p. INIS.

After its successful operation as a PWR, the Belgian BR 3 Plant has been used for testing fuel designs and fabrications in power reactor conditions. In particular, the BR 3 reactor contributes to the Belgian program of plutonium recycle in LWR's. (INIS)

20334 (INIS-mf-830) ENEL's VIEWPOINT ON Pu RECYCLE IN WATER REACTORS. Ariemma, A. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1973. 10p. INIS.

ENEL has long acknowledged the importance of plutonium recycle in thermal reactors; as a matter of fact, ENEL was faced with this problem before the other electric utilities because it operated a graphite-Magnox station at Latina with a high plutonium production, and two light water stations, Garigliano and Trino Vercellese, in which plutonium might be recycled. In 1966 ENEL, in collaboration with EURATOM, launched an extensive research program, while a Demonstration Program is still under way in the 160-MW(e) boiling water reactor of the Garigliano station. Sixteen plutonium prototype assemblies were loaded in this reactor, with about 900 mixed-oxide rods and a total weight of 3 tons of fuel. ENEL shares the opinion of several other utilities about the advisability to recycle the plutonium quantities exceeding the requirements for research and demonstration fast reactors. Recycling in thermal reactors shall be interrupted when, owing to the approaching of the commercial advent of fast reactors, the plutonium shall be stored for more rational utilizations. In the present commercial phase of plutonium recycle in thermal reactors, the economic conditions for recycling seem to encourage the utilities, thus justifying intensive plutonium utilizations in those thermal reactors in which the technical-economic analysis indicate the higher value of this fissile material. (INIS)

20335 (ORNL-TM-4443, pp vp Paper 13) MODEL FOR CALCULATING THE INCREMENTAL FUEL COST OF REACTOR OPERATING STRATEGIES. Omberg, R. P. (Hanford Engineering Development Lab., Richland, WA). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

A code has been developed for the specific purpose of calculating the incremental cost of any reactor operating strategy. The code contains both a reactor model and a cost model. It is capable of performing coupled multi-cycle reactor depletion calculations, since previous history determines subsequent costs. It is capable of shuffling fuel in any desired fashion between cycles. Since the fissile inventory at the end of one cycle determines the beginning state for the next cycle, it is necessary to converge the end-of-cycle eigenvalue to a specified value. This is in addition to the normal inner iteration to converge the flux, and the normal outer iteration to converge the eigenvalue. Since the problem is one of nonequilibrium reactor operation, axial power profiles will vary from batch-to-batch and from cycle-to-cycle in a non-repetitive fashion. Furthermore, they will vary substantially within a cycle. Thus, it may be necessary that the reactor model have an axial dimension, in addition to a radial one. Finally, since the code is to be used to evaluate alternatives, it is necessary that it accomplish the above tasks with reasonable rapidity. A model which meets these requirements and some results obtained from it are presented. (19 references) (auth)

20336 (ORNL-TM-4443, pp vp Paper 14) SIMULATION AND OPTIMIZATION OF NUCLEAR FUEL RELOADING DECISIONS. Kearney, J. P.; Watt, H. Y.; Benedict, M.; Mason, E. A. (Massachusetts Inst. of Tech., Cambridge). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The present AEC contracts for uranium enrichment services require utilities to specify the amount of separative work needed for their nuclear plants from eight to ten years in advance of fuel delivery. This necessitates much more detailed and advanced planning than has hitherto been done by nuclear utilities. This planning must consider how the nuclear plants in the system will compete amongst themselves and with fossil and hydro plants for shares of the projected system energy demands. Studies have shown that even simplistic guidelines for deciding on the amount of energy to be produced from nuclear plants can be useful to utility system planners, e.g., irrespective of whether full cycle design burnup is achieved for a nuclear plant a strategy which uses nuclear plants solely to displace 30 cents/MBTU fossil energy saves on over-all system fuel costs. Optimizing the energy produced in each nuclear fuel cycle for all nuclear plants on the system has been shown to save even more. Beyond this, optimizing the nuclear fuel used to produce these cycle energies will reap even additional savings. It is this last level of optimizing that shall be considered here. The general characteristics of this level of nuclear fuel optimization and its required core simulation are presented first to set the stage for the specific nuclear optimizations discussed later. The in-core simulator is discussed in detail followed by a description of its use in various nuclear fuel optimization procedures. Finally, the results of all of these optimizations are discussed and an outlook on future nuclear reload fuel concerns is presented. (13 references) (auth)

20337 (ORNL-TM-4443, pp vp Paper 16) INTERSTAGE COUPLING EFFECTS IN LWR FUEL MANAGEMENT. Rothrock, R. B. (Hanford Engineering Development Lab., Richland, WA). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

At the intermediate level of the decomposition scheme interstage coupling effects for individual reactors become most important. In recognition of the long-term planning implied at this level, it is proposed that a scheme for accomplishing the multistage optimization should: (1) incorporate varying enrichment of the replacement fuel batches as well as varying batch size; (2) focus on fuel batch parameters important to advance fuel procurement and cost comparisons of alternate system operating strategies rather than on detailed in-core fuel arrangement schemes, where possible; and, (3) evaluate alternate multistage refueling strategies based on their total costs over the planning period, with less emphasis on the allocation of costs to specific batches or operating periods. The work reported here is addressed to this intermediate optimization level, where a long term refueling strategy for an individual plant, characterized by the replacement batch sizes and enrichments, is sought which satisfies the desired energy production schedule at minimum total cost. (19 references) (auth)

20338 (ORNL-TM-4443, pp vp Paper 18) FUEL MANAGEMENT SIMULATION STUDIES AT WESTINGHOUSE. Henderson, R. R.; Bauhs, D. J. (Westinghouse Electric Corp., Pittsburgh). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

The CYCEC modular fuel management system was designed to make the maximum utilization of actual fuel operating experience and of results obtained with more detailed design calculations by the use of simplified simulation methods. The system is supported by a continuing development program and is frequently updated with feedback from operating plants. Two basic goals in the development of the system were to obtain ease of use and speed of computer execution. The modular concept provides maximum flexibility in the use of the system with a minimum amount of manipulation by the user. Though the variety of applications for the system precludes a definitive statement as to the computer running time, a typical total running time using all of the optional modules is approximately four seconds on a CDC 7600. The CYCEC system satisfies Westinghouse's requirements for an accurate and rapid simulation of fuel management and performance of the Westinghouse PWR. (auth)

20339 (ORNL-TM-4443, pp vp Paper 20) PODECKA: A PSEUDO ONE-DIMENSIONAL POINT DEPLETION ALGORITHM. Kazemersky, P. M. (Tennessee Valley Authority, Chattanooga). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

PODECKA is a computer code designed to represent (in a simplified sense) the neutronics and consequently the economics of a nuclear power reactor. The code is capable of standing alone to provide a simplified isotopic and economic analysis of a nuclear unit. The code may also be incorporated as a portion of a system integration model. The motivation for development was, in fact, to have an algorithm which would provide a means of determining with reasonable accuracy the costs of operating a nuclear unit under different operating schemes. The costs generated by PODECKA would then be employed in the objective function of a system integration model. Consequently, the code

must function primarily as a fast, simple and easily applied algorithm generating the necessary isotopic data for calculation of nuclear fuel cycle cost. PODECKA makes use of this data to determine nuclear fuel cycle unit costs in cents per million Btu's including indirect charges. PODECKA will also calculate a levelized fuel cycle cost. The structure of PODECKA is patterned after the structure of NUCSIM. However, the logic used in PODECKA is quite independent of the methods employed in codes developed prior to this algorithm. PODECKA makes all nuclear decisions according to rigid rules. 4 references. (auth)

20340 (ORNL-TM-4443, pp vp Paper 29) POWER SYSTEM NETWORK EXPANSION USING GRADIENT METHOD. Puntel, W. R.; Wood, A. J. (Power Technologies, Inc., Schenectady, NY). Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

In considering the long-range future development of power systems, the role played by the available transmission system alternatives in influencing the optimum growth pattern is expected to become increasingly important. There has been an inherent economy of scale in overhead power transmission systems that causes the unit cost (i.e., dollars per peak kW transmitted per unit distance) to come down with increasing voltage. The feasible and economic circuit power levels increase at least as the square of the voltage level. On the other hand, circuit costs and land use penalties rise approximately in direct proportion to the voltage. The net result is a natural decreasing cost per kW per mile transmitted. Because of environmental and economic pressures overhead transmission right-of-way is becoming more difficult and expensive to obtain, and the optimum generating plant size for a given area or utility could be severely limited. Therefore, it is not prudent to ignore the required transmission facilities when exploring the future roles of nuclear energy in alternative system growth philosophies. In fact for some alternatives, particularly large nuclear parks, transmission requirements may prove to be the prime constraint. For purposes of long-range system planning, an automated transmission planning program will facilitate the evolvement and analysis of transmission expansion plans. The program described is based on a dc network model used in combination with a gradient optimization technique for guiding the network design. 12 references. (auth)

20341 NUCLEAR FUEL INDUSTRY. Hill, J. (Inst. of Fuel, London). pp 83-103 of Fuel and the Environment. Conference Proceedings, Volume 1. London; Inst. of Fuel (1973).

From conference on fuel and the environment; Eastbourne, Eng. (26 Nov 1973).

The use of atomic power as a means of producing electrical energy is now very well established, and the number of nuclear reactors is increasing rapidly. A supporting nuclear fuel industry has evolved which is capable of providing a whole range of services from conversion of imported uranium ore concentrate, through to transport and reprocessing of irradiated fuel elements. These operations are outlined, and a brief description is given of the more important reactor systems. Statistics are presented which demonstrate the economic and logistical advantages associated with nuclear energy. The basic standards, which have been laid down by international bodies, setting maximum limits to the radiation dose to which the population can be exposed, are discussed; as is the legislation which has been enacted to control radioactive discharges from major nuclear sites in the UK, and to provide for the licensing of nuclear installations. The operations of nuclear fuel reprocessing plants are described, and the means of controlling discharge of low-activity waste to sea, and of monitoring any possible impact on the environment, are discussed. Highly active liquid wastes are at present stored in high-integrity tanks and proposals to turn this waste into a solid form are outlined. Solid radioactive wastes have been disposed of at sea, and the precautions exercised are described. Transport of radioactive materials is subject to regulatory standards laid down by the International Atomic Energy Agency and there is considerable experience in the UKAEA/BNFL of transporting these materials safely. Finally, the UKAEA research and development programme is detailed. This is aimed at ensuring that the present very high standards of radioactive waste treatment, storage, etc., are more than maintained in the future. (auth)

Reactor Licensing and Regulation

20342 (ANCR-1011(Pt.1)) FINAL SAFETY ANALYSIS REPORT FOR THE POWER BURST FACILITY. Part I. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jul 1971. Contract AT(10-1)-1375. 702p. Dep. NTIS $37.25.

Information on the Power Burst Facility is presented concerning the reactor site, design characteristics, coolant systems, engineered safety systems, buildings and structures, instrumentation, and control systems. (DCC)

20343 (ANCR-1011(Pt.2)) FINAL SAFETY ANALYSIS REPORT FOR THE POWER BURST FACILITY. Part II. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jul 1971. Contract AT(10-1)-1375. 569p. Dep. NTIS $30.50.

Information on the Power Burst Facility is presented concerning electrical power distribution system, auxiliary and emergency systems, radioactive wastes and radiation protection, conduct of operations, initial tests and operations, safety analysis, and compliance to design criteria in Appendix A of 10CFR50. (DCC)

20344 (DOCKET-50003-246) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-1: the High Pressure Boron Addition System was Unavailable for Service; Abnormal Occurrence Report No. AO-4-1-2: Freezing of the Impulse Lines to the Differential Pressure Sensors; Abnormal Occurrence Report No. AO-4-1-3: Failure of the Drive Key on the No. 12 Main Steam Stop Valve Motor Operator. (Consolidated Edison Co. of New York, Inc., New York (USA)). 28 Jan 1974. 3p. Dep. NTIS $3.00.

20345 (DOCKET-50213-260) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-74-2: Malfunction of Two Main Steam Line Excessive Flow Differential Pressure Transmitters. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 18 Jan 1974. 1p. Dep. NTIS $3.00.

20346 (DOCKET-50213-269) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-74-3: Total Loss of Station Service Power and Failure of the Service Water Pumps. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 1 Feb 1974. 2p. Dep. NTIS $3.00.

20347 (DOCKET-50219-365) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-2: Malfunction of RE22 Main Steam Line High Flow Sensors. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 17 Jan 1974. 3p. Dep. NTIS $3.00.

20348 (DOCKET-50219-388) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Incident Report: Unexplained Isolation of the "B" Isolation Condenser. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 2 Jan 1974. 3p. Dep. NTIS $3.00.

20349 (DOCKET-50219-400) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-8: Malfunction of Reactor High Pressure Isolation Condenser Initiation Switches. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 29 Jan 1974. 4p. Dep. NTIS $3.00.

20350 (DOCKET-50219-401) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-6: Twenty-Four Hours After Placing the Mode Selector Switch into RUN, the Torus Atmosphere Contained 6.2% O_2 Which Exceeds Specified Limits. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 23 Jan 1974. 4p. Dep. NTIS $3.00.

20351 (DOCKET-50219-402) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-74-3: Failure of Hydraulic Shock and Sway Arrestors on One Core Spray System and on Both Isolation Condenser Systems. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 24 Jan 1974. 3p. Dep. NTIS $3.00.

20352 (DOCKET-50219-404) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. 74-5: Malfunction of Main Steam Isolation Valve NSO4A. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 25 Jan 1974. 3p. Dep. NTIS $3.00.

20353 (DOCKET-50237-449) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence Report: Malfunction of 2/3 Core Height Water Level Sensors LITS 2-263-73A and B. (Commonwealth Edison Co., Chicago, Ill. (USA)). 17 Jan 1974. 2p. Dep. NTIS $3.00.

20354 (DOCKET-50247-203) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-4: a Small Leak Was Observed at the Upstream Orifice Flange Connection for Flow Transmitter 946D in the Residual Heat Removal System

Return Line to the Reactor Coolant Loop. (Consolidated Edison Co. of New York, Inc., New York (USA)). 21 Jan 1974. 1p. Dep. NTIS $3.00.

20355 (DOCKET-50247-204) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-5: a Slight Reactor Coolant System Pressure Transient Was Experienced in the Course of Placing a Reactor Coolant Pump in Service. (Consolidated Edison Co. of New York, Inc., New York (USA)). 28 Jan 1974. 2p. Dep. NTIS $3.00.

20356 (DOCKET-50249-350) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence Report: Condenser Low Vacuum Scram Switch Drift. (Commonwealth Edison Co., Chicago, Ill. (USA)). 22 Jan 1974. 2p. Dep. NTIS $3.00.

20357 (DOCKET-50249-351) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence Report: Failure of Electromatic Relief Valve 3-203-3A. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Jan 1974. 3p. Dep. NTIS $3.00.

20358 (DOCKET-50249-352) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence Report: HPCI System Was Found to be Inoperable. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Jan 1974. 3p. Dep. NTIS $3.00.

20359 (DOCKET-50254-308) QUAD-CITIES STATION, UNITS 1 AND 2. Abnormal Occurrence: Chlorine Residual Concentrations in the Discharge Bay Exceeded Specifications. (Commonwealth Edison Co., Cordova, Ill. (USA)). 28 Jan 1974. 2p. (DOCKET-50265-290). Dep. NTIS $3.00.

20360 (DOCKET-50259-310) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report Nos. BF EAO-748W Through 7414W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 25 Jan 1974. 2p. Dep. NTIS $3.00.

20361 (DOCKET-50259-312) BROWNS FERRY NUCLEAR POWER STATION, Unit 1. Abnormal Occurrence Report BFAO-745W: Leakage in the Shaft Seal Packing on 1B SLC Pump. (Tennessee Valley Authority, Chattanooga (USA)). 25 Jan 1974. 2p. Dep. NTIS $3.00.

20362 (DOCKET-50259-316) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-746W: Radioactive Material Was Released to the Unit 2 Reactor Building Floor Drain Sumps. (Tennessee Valley Authority, Chattanooga (USA)). 30 Jan 1974. 3p. Dep. NTIS $3.00.

20363 (DOCKET-50263-292) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Malfunction of a RCIC Steam Line High Temperature Switch. (Northern States Power Co., Minneapolis, Minn. (USA)). 30 Jan 1974. 1p. Dep. NTIS $3.00.

20364 (DOCKET-50269-192) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report No. UE-73-15: Malfunction of Engineered Safeguards Valve HP-20 in the Reactor Coolant Pump Seal Return Header. (Duke Power Co., Charlotte, N. C. (USA)). 25 Jan 1974. 2p. Dep. NTIS $3.00.

20365 (DOCKET-50277-182) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence Report: Electrical Fault on E-4 Diesel Generator Current Transformers. (Philadelphia Electric Co., Pa. (USA)). 25 Jan 1974. 1p. Dep. NTIS $3.00.

20366 (DOCKET-50282-205) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Instrumentation Setpoints Found Outside of Allowable Limits. (Northern States Power Co., Minneapolis, Minn. (USA)). 25 Jan 1974. 2p. Dep. NTIS $3.00.

20367 (DOCKET-50285-165) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report No. AO-74A-1: Diesel Generator (D-1) Starting Failure; Diesel Generator (D-2) Low Lube Oil Pressure Trip. (Omaha Public Power District, Nebr. (USA)). 17 Jan 1974. 4p. Dep. NTIS $3.00.

20368 (DOCKET-50293-227) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-74-3: Incident in the Handling of Irradiated Fuel. (Boston Edison Co., Mass. (USA)). 21 Jan 1974. 2p. Dep. NTIS $3.00.

20369 (DOCKET-50305-147) KEWAUNEE NUCLEAR POWER PLANT, PERFORMANCE OF DIESEL GENERATORS AND MALFUNCTION OF AIR PRESSURE REGULATOR VALVE. (Wisconsin Public Service Corp., Green Bay (USA)). 24 Jan 1974. 2p. Dep. NTIS $3.00.

20370 (DOCKET-50309-171) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. AO-74-1: Malfunction of Protective Channel Pressure Switches. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 14 Jan 1974. 1p. Dep. NTIS $3.00.

20371 (DOCKET-50309-173) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence No. 74-2: The Limiting Linear Heat Rate Value Exceeded Its Local Limit. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 20 Jan 1974. 1p. Dep. NTIS $3.00.

20372 (DOCKET-50312-100) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Modification of Snubber Seal on Bergen-Paterson Hydraulic Snubbers. (Sacramento Municipal Utility District, Calif. (USA)). 21 Jan 1974. 3p. Dep. NTIS $3.00.

20373 (DOCKET-50317-152) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Significant Deficiency Report: Use of Incorrect Discs in the High-Pressure Safety-Injection System. (Baltimore Gas and Electric Co., Md. (USA)). 4 Jan 1974. 3p. (DOCKET-50318-130). Dep. NTIS $3.00.

20374 (DOCKET-50324-141) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Evaluation of Alternate Cooling Systems. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 4 Feb 1974. 58p. (DOCKET-50325-136). Dep. NTIS $5.00.

Closed-cycle cooling systems including natural draft cooling towers, mechanical draft cooling towers, and spray module canal cooling were evaluated. Spray modules have experienced a significant number of problems using fresh water so they can not be considered for saltwater service. Mechanical draft cooling towers have been used in saltwater service but maintenance cost makes this type cooling much too costly. Natural draft towers with minimal parts to fail, due to corrosion, have a high reliability. Should a closed cooling system be required, natural draft towers would be the best selection. (FS)

20375 (DOCKET-50409-93) LACROSSE BOILING WATER REACTOR. Technical Evaluation of the Adequacy of the Emergency Core Cooling System. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 17 Jan 1974. 36p. Dep. NTIS $4.00.

20376 (DOCKET-50409-95) LA CROSSE BOILING WATER REACTOR. Investigation of Failed Pipe Nipples in the Core Spray Cooling System, Final Report. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 23 Jan 1974. 31p. Dep. NTIS $3.75.

Failed type 304 stainless steel pipe nipples, which form the connection between a socket fitting and a hexagonal threaded coupling, were examined. The nipples were fabricated from cold-worked bar stock with machining producing additional cold-work. They were not solution annealed after fabrication. Cracking initiated at the thread roots and propagated to the point where the remaining ligament failed by tensile overload. Crack growth was intergranular with corrosion product on the fracture surface but with no evidence of plastic deformation. Replacement of the nipples with austenitic stainless fittings which are solution annealed after fabrication should eliminate similar failures. (FS)

20377 (DOCKET-50416-65) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. AEC Safety Evaluation. (Mississippi Power and Light Co., Jackson (USA)). Jan 1974. 304p. (Docket-50417-65). Dep. NTIS $17.25.

Results of the technical evaluation performed by the Regulatory staff are summarized and the scope of the technical matters considered in evaluating the radiological safety aspects of the proposed facility are delineated. Assuming favorable resolution to the outstanding matters, which are described, the facility can be constructed and operated without endangering the health and safety of the public. (FS)

20378 (DOCKET-50434-33) SURRY POWER STATION, UNITS 3 AND 4. License Application, Environmental Report, Volume 2. (Virginia Electric and Power Co., Richmond (USA)). Apr 1973. 372p. (DOCKET-50435-33). Dep. NTIS $20.75.

Appendices for the Environmental Report are presented concerning geology and hydrology, excerpts from Surry-1 and -2 PSAR amendments, source terms, Surry County data summary, James River studies, non-radiological and radiological monitoring programs, evaluation of the doses from estimated radioactive effluents, transmission line profile drawing, and source terms for AEC Appendix 2 questionnaire. (FS)

20379 (DOCKET-50434-34) SURRY POWER STATION, UNITS 3 AND 4. License Application, PSAR, Geotechnical Report. (Virginia Electric and Power Co., Richmond (USA)). 15 Jun 1973. 411p. (DOCKET-50435-34). Dep. NTIS $22.75.

The reactor site is underlain by approximately 70 feet of Pleistocene sands and clays, 200 ft of overconsolidated Miocene clays, and 1000 ft of geological unconsolidated older sediment. The in-situ Pleistocene sands are susceptible to liquefaction and should be densified to a minimum of 70% relative density to preclude liquefaction during the postulated Safe Shutdown Earthquake. All structures can be founded on the densified sands, the compacted sands or the overconsolidated clays. Appendixes included are laboratory test data, cycle triaxial test, in-situ seismic velocity, tests and boring logs. (FS)

20380 (FIND-50315-S1) FIND: DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 37p. Dep. NTIS $4.00.

A supplemental index is given for D. C. Cook Nuclear Plant docket report material, covering the period from July 1973 to December 1973. This FIND presents a detailed outline of items 128-157. The entries are arranged under two major categories: (1) Technical Information [including the Final Safety Analysis Report (FSAR) (updated with the insertion of material in Amendments 45-50)] and (2) Environmental Information. Special emphasis is placed on ice condenser information in the FSAR chapters, the responses to AEC questions, and the proposed technical specifications as well as references to older ice condenser material by consultants. [See FIND-51315 (August 1973) for the index to construction-permit-stage items and operating-license-stage items (1-127) for the period from February 1971 to June 1973.] (auth)

20381 (FIND-50336) FIND: MILLSTONE NUCLEAR POWER STATION, UNIT 2. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 35p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

20382 (FIND-50416) FIND: GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Items 1-59. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 27p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

20383 (FIND-50423) FIND: MILLSTONE NUCLEAR POWER STATION, UNIT 3. Asher, J. M. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 29p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

20384 (FIND-50424) FIND: ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Williams, W. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 32p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

20385 (PRDI-74-2) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 49p.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

20386 (RDT-F-9-2-T(1-74)) SEISMIC REQUIREMENTS FOR DESIGN OF NUCLEAR POWER PLANTS AND TEST FACILITIES. (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1974. 25p. RSO.

Engineering requirements for the design of nuclear power plants and test facilities to accommodate the vibratory effects of earthquakes are presented. This standard is applicable to the containment, all components within and including the reactor coolant pressure boundary, engineered safety features, and to all systems or components that are required to permit continued operation. (JWR)

20387 (REG/G-1.29(Rev.1)(8-73)) SEISMIC DESIGN CLASSIFICATION. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Aug 1973. 2p. DRS.

20388 (REG/G-1.49(Rev. 1)(12-73)) POWER LEVELS OF NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 2p. DRS.

20389 (REG/G-1.56(6-73)) MAINTENANCE OF WATER PURITY IN BOILING WATER REACTORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1973. 4p. DRS.

20390 (REG/G-1.59(8-73)) DESIGN BASIS FLOODS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Aug 1973. 16p. DRS.

An acceptable method is described for determining for sites along streams or rivers the design basis floods that nuclear power plants must be designed to withstand without loss of safety-related functions. The phenomena producing comparable design basis floods for coastal, estuary, and Great Lakes sites are discussed. The design requirements for flood protection are not included. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position. (auth)

20391 (REG/G-1.60(Rev. 1)(12-73)) DESIGN RESPONSE SPECTRA FOR SEISMIC DESIGN OF NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 6p. DRS.

20392 (REG/G-1.61(10-73)) DAMPING VALUES FOR SEISMIC DESIGN OF NUCLEAR POWER PLANTS. USAEC Directorate of Regulatory Standards, Washington, D. C.). Oct 1973. 2p. DRS.

The damping values acceptable to the AEC Regulatory staff to be used in the elastic modal dynamic seismic analysis of Seismic Category 1 structures, systems, and components are described. (auth)

20393 (REG/G-1.70.2(12-73)) AIR FILTRATION SYSTEMS AND CONTAINMENT SUMPS FOR NUCLEAR POWER PLANTS; ADDITIONAL INFORMATION. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 2p. DRS Washington, DC Free.

20394 (REG/G-8.8(7-73)) INFORMATION RELEVANT TO MAINTAINING OCCUPATIONAL RADIATION EXPOSURE AS LOW AS PRACTICABLE (NUCLEAR REACTORS). (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jul 1973. 4p. DRS.

20395 (REG/G-9.1(12-73)) REGULATORY STAFF POSITION STATEMENT ON ANTITRUST MATTERS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1973. 4p. DRS.

20396 (VITRO-MA-6) FIELD ENGINEERING PERSONNEL CERTIFICATION MANUAL. General Revision. (Automation Industries, Inc., Richland, Wash. (USA). Vitro Engineering Div.). Apr 1973. 171p. Dep. NTIS $10.25.

In order to meet US AEC Division of Reactor Development and Technology quality assurance requirements for nuclear plant construction, inspection, surveying, and related engineering functions, Vitro Engineering Div. of Automation Industries, Inc. developed a comprehensive program for the formal training, examination, and certification of its field and survey personnel. This manual describes the scope of the program, the certification procedure and documentation, and the personnel qualifications and associated certification requirements for each of 17 subject categories within five areas which are designated as: architectural and civil inspection; metal examination; electrical and instrumentation inspection; mechanical inspection; and surveying. The training course materials and examinations are not included, but are available. (LCL)

20397 LICENSING AND REGULATORY CONTROL OF THERMAL POWER REACTORS IN THE UNITED KINGDOM. Gronow,

W. S.; Gausden, R. (Dept. of Trade and Industry, London). J. Inst. Nucl. Eng.; 14: No. 5, 131-137(Sep 1973).

From principles and standards of reactor safety; Juelich, Germany (Feb 1973).

The regulation of nuclear safety in the United Kingdom is governed by the Nuclear Installations Acts 1965 and 1969. The Acts are administered in England and Wales by the Secretary of State for Trade and Industry and in Scotland by the Secretary of State for Scotland. These Ministers have very wide discretion in the use of their regulatory powers and no body other than the Atomic Energy Authority or a Government Department may construct or operate a nuclear reactor or other prescribed installation without the site being licensed by the responsible Minister. The Ministers are also empowered to attach to a nuclear site license any conditions considered necessary for safety and these conditions can then be legally enforced under statutory penalties. The flexibility of these powers makes it possible to frame conditions appropriate for the protection of operators and the public from ionizing radiations for any of the licensed sites. The Ministers are assisted in the detailed execution of the Act and in framing the conditions attached to site licenses by the Nuclear Installations Inspectorate. The experience gained in applying safety controls to nuclear power plants in the United Kingdom is summarized and an outline is given of some of the changes made to meet the problem of regulating a developing and expanding industry. (auth)

20398 REGULATION OF NUCLEAR POWER REACTORS AND RELATED FACILITIES. Nucl. Safety; 15: No. 1, 1-13(1974).

The U. S. Atomic Energy Commission (AEC) has the responsibility to protect the health and safety of the public by assuring that an owner/operator designs, builds, and operates, and maintains the integrity of a nuclear facility over its lifetime in accordance with the criteria, codes, standards, and regulatory judgments directed toward that end. The philosophy and means for protecting the public health are discussed. The relevant AEC rules and regulations, as well as the details of the licensing process and the AEC inspection program, are summarized. 19 references. (auth)

20399 SO-CALLED NUCLEAR POWER MORATORIUM IN SWEDEN. Nucl. Safety; 15: No. 1, 14(1974).

The proposal for a formal moratorium was rejected by Parliament by 218 votes to 70, and the appropriations to the different sectors of the nuclear power program received parliamentary approval. Accordingly the position taken by the parliament will not affect the 11 power reactors: Oskarshamn (three units), Ringhals (four units), Barseblick (two units), and Forsmark (two units), which are all to be completed before the end of 1980. The long-term plans of the utilities envisage the completion of 13 more power reactors between 1971 and 1990. Representatives of the power utilities in Sweden have since commented that they saw no difficulty in awaiting the presentation of further information to Parliament in 1974 before decisions are taken on new nuclear power plants. (auth)

20400 LICENSING PROCEDURES IN THE FEDERAL REPUBLIC OF GERMANY ACCORDING TO THE ATOMIC ENERGY LAW. Schnurer, H. (Bundesministerium fuer Bildung und Wissenschaft, Bonn). DAtF Sonderdrucke; No. 1, 3-30(1972). (In German).

A diagrammatic view is given of the licensing procedure for nuclear power plants presently followed in the FRG. The schedule set up by this procedure has raised some contradiction, especially on the part of industry and the utilities. (GE)

20401 COMMISSIONING OF THERMAL POWER PLANTS WITH MORE THAN 100 MW(e) IN THE FRG 1972-1973. Atomwirt., Atomtech.; 18: No. 11, 544-545(Nov 1973). (In German).

A table is given showing the various power plants, the year of commissioning and other data such as owners or operators of the plants, their capacity and the type of fuel used. In addition, a map is given showing the sites of the particular plants. (GE)

GENERAL

Civilian Defense

20402 (ORNL-tr-2793) CIVIL DEFENSE. Second Edition. Egorov, P. T.; Shlyakhov, I. A.; Alabin, N. I. (Oak Ridge National Lab., Tenn. (USA)). 1970. Translation of Grazhdanskaya Oborona, Vysshaya Shkola, Moscow 1970. 239p. Dep. NTIS $7.60.

Besides protection of the population, this book also discusses protection and strengthening of essential industries so that they can continue production after a nuclear attack. Performing rescue and emergency-repair work in stricken areas is also given emphasis. Procedures for evacuation and dispersion are described in detail. Radiation detection instruments are considered in one chapter. (DLC)

Energy Utilization and Economics

Refer also to abstracts 18975, 20496, 20503, and 20526.

20403 (AEC-tr-7509) PROBLEMS ON DEVELOPMENT OF SUPERCONDUCTING POWER TRANSMISSION LINES. Bendik, N. T.; Blinkov, E. L. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). 1973. Translation of Problemy sozdaniya sverkhprovodyashchikh liniy, 1973, Moscow. 36p. Dep. NTIS $4.00.

The six articles included here relate to problems facing the developers of superconducting power transmission lines and their solution, namely: (1) theoretical and experimental investigations related to analysis of electromagnetic, thermophysical, and hydrodynamic processes that take place in power transmission lines; (2) cryogenic high-voltage insulation, basic requirements on insulation constructions, the types of cryogenic insulation, the advantages of coolant and vacuum as the basic insulation, and the scientific research program on high-voltage insulation; (3) investigation of properties of superconducting ac cable (SCC) lines that are largely determined by their transmitting capacity; (4) features of heat exchange and hydrodynamics of SCC that are associated with the fact that the range of working parameters of the basic coolant of SCC is the near-critical range; (5) character of pulsation modes and conditions under which they occur in choice of working parameters of the coolant; and (6) in developing superconducting cables, the problems of measuring the parameters of SCC, automation of measurements, and control, regulation, and safety. (MCW)

20404 (BNL-18430) EVALUATION OF THE TECHNICAL, ECONOMIC, AND ENVIRONMENTAL FEATURES OF A SYNTHETIC FUELS ECONOMY BASED ON FUSION REACTORS. Powell, J.; Salzano, F.; Sevian, W.; Hoffman, K.; Bezler, P. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1973. 103p. Dep. NTIS $7.25.

The technology, economics, and environmental effects of producing synthetic fuels based on fusion (CTR) reactors are assessed. In this analysis, H_2 gas is produced by electrolysis of water (electricity is supplied from CTR reactors); H_2 liquid is produced from H_2 gas by conventional liquefaction, and methanol is produced by reaction of CO_2 (extracted from the atmosphere) and H_2 gas. Four U. S. energy systems from 2020 AD with different degrees of CTR implementation are compared in terms of overall cost and environmental effects. In System A, no CTR input is assumed, and the energy inputs are nuclear electric, hydropower, coal, oil, and gas; in System B, CTR's replace 50% of nuclear electric; in System C, CTR's supply all electrical demand, plus electricity to make enough synthetic fuels to replace all oil and gas imports, as well as the elimination of strip mining; and in System D, CTR's supply all electrical demand and virtually all fuel demand. CTR reactor costs are analyzed in detail for a range of containment parameters, reactor outputs [5 GW(e) to 20 GW(e)] and first wall loadings (1 to 4 MW(th)/m^2), and for DT and catalyzed DD fuel cycles. (auth)

20405 (BNWL-SA-4843) USE OF LINEAR PROGRAMMING TO MODEL BUSINESS AND CONSUMER DECISION MAKING RELATED TO ENERGY CONSUMPTION. Deonigi, D. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 32p. (CONF-731130-2). Dep. NTIS $3.75.

From Operation Research Society of America; San Diego, California, USA (12 Nov 1973).

Models that predict the response of business and consumers to changes in energy cost have been made previously, but with today's erratic economy, the models do not apply. Prices are rising at an unprecedented rate and the availability and environmental controls also influence the choice of fuels as well as price. With these factors, the new linear programming was designed to determine the electrical generation supply for the next 50 years taking into account the advent of nuclear power. The model is formulated to simulate a schedule of building power plants that will supply projected energy requirements while also satisfying constraints representing material balances, technological introduction rate constraints, fuel price step functions, committed plant construction, and fuel-processing capacity. (MCW)

20406 (CONF-721234-) OUTLOOK FOR ENERGY CONFERENCE, MINNEAPOLIS, MINNESOTA, DECEMBER 7-8, 1972. (Upper Midwest Council, Minneapolis, Minn. (USA)). Dec 1972. 94p.

From Outlook for energy conference; Minneapolis, Minnesota, USA (7 Dec 1972).

Nine papers were presented at the conference on energy in Dec. 1972. Supply and demand, economics, the environmental impact, alternative sources, and some governmental views are presented. (MCW)

20407 (NP-19944) MHD SYSTEM WITH DUAL-PRESSURE MELT GASIFICATION AND CO_2 RECYCLE. Research and Development Report No. 58. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). 1970. Contract 14-01-0001-1199. 46p. GPO $0.55.

Thermodynamic and design parameters of a system for generation of electrical power from cool or char by the MHD process, which features utilization of exhaust stream heat for the endothermic heat of reaction in a char gasification process, are described. (TFD)

20408 (NP-19945) ENGINEERING EVALUATION OF PROJECT GASOLINE: CONSOL SYNTHETIC FUEL PROCESS. Research and Development Report No. 59. (Foster Wheeler Corp., Livingston, N. J. (USA)). 28 Jul 1970. Contract 14-32-0001-1203. 192p. GPO $2.75.

Project Gasoline is a project to develop a process for converting coal to gasoline at an economical price. Designs were completed for the construction of a pilot plant with a capacity of slightly less than one ton per hour of coal (equivalent to slightly less than 60 barrels per day of a synthetic crude). The pilot plant was intended to provide process data for design of a full-scale commercial plant. The pilot plant was dedicated in May 1967, but after 56 runs that terminated by mechanical and plant failure, sufficient data is lacking for the design of a commercial facility. After the closing of the plant, the engineering evaluation summary was made. (MCW)

20409 (NP-19946) SELECTION OF COALS FOR THE AVCO HYDROGEN PLASMA ARC PROCESS FOR MAKING ACETYLENE. Research and Development Report No. 61, Interim Report No. 5. Given, P. H. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science). 1 Mar 1973. Contract 14-01-0001-390. 13p. GPO $0.50.

A set of 30 samples of coals from different regions of the U. S. and of various ranks were selected from the Penn State sample collection and tested by AVCO for acetylene production. It was found that the most effective coals are the high volatile bituminous, the yield falling off with either medium volatile bituminous or subbituminous. Since the high volatile bituminous class is a large one and there was an appreciable range of yields within it, attempts were made to identify the most effective coals more specifically. Within the class no clear correlations could be found with such parameters as volatile matter, hydrogen content, or reflectance, nor with empirical combinations of these, though there does appear to be a somewhat greater probability of obtaining good acetylene yields if the reflectance is at the lower end of the range for highly volatile bituminous coals. There are indications that western coals tend to have more hydrogen in relation to their carbon than other coals, but there was no evidence that this increased the acetylene yield. Examination of the solid by-product of the processing of these coals suggested that the coal feed had been nonuniformly exposed to the high-temperature reducing conditions. It was thought that differences in acetylene yield might reflect accidental differences in processing conditions rather than true differences in the organic substance of the coals. Accordingly, the results were not reported, and a fresh set of 30 samples was submitted for testing under modified conditions that should ensure uniform exposure of the feed. (MCW)

20410 (NP-19947) REMOVAL OF SULFUR FROM COAL BY TREATMENT WITH HYDROGEN. Phase I. The Effect of Operating Variables and Raw Material Properties. Research

and Development Report No. 77, Interim Report No. 1. Gary, J. H.; Baldwin, R. M.; Bao, C. Y.; Kirchner, M.; Golden, J. O. (Colorado School of Mines, Golden (USA)). 30 May 1973. Contract 14-32-0001-1225. 108p.

The purpose of this investigation was to determine which process variables had a significant effect on the desulfurization of coal by hydrogen treatment at reaction temperatures of 325 and 400°C; pressures of 600 and 1200 psig; reaction times of 7.5 and 15 min; solvents of anthracene and tetralin; and solvent-to-coal ratios of 3/1 and 4.5/1. A coal–solvent slurry was reacted with hydrogen at elevated temperatures and pressures in a batch autoclave rocking bomb reactor. Four different raw coals (two bituminous and two sub-bituminous) were tested. Both solvent type and temperature were found to be very highly significant variables (99% confidence level) in the solvent refining process for the desulfurization of coal. Some significance (90% confidence level) of the solvent-to-coal ratio was demonstrated for the sub-bituminous coals. Anthracene oil was found to be a better solvent for the process than tetralin since the dissolution of the coal in the anthracene was greater and the hydrogen transfer characteristics appeared to be better in comparison to the tetralin. The tetralin solvent was totally recoverable from the solvent-refined product, while the anthracene oil was only partially recoverable (50 to 80%) since the coal was only partially depolymerized under reaction conditions investigated. Inorganic sulfur was easily removed from the raw coal by the solvent-refining technique (98%) while organic sulfur was removed to a lesser degree (81%). The degree of dissolution and depolymerization of the coal in the solvent was an important process factor for overall desulfurization. (MCW)

20411 (ORNL-HUD-MIUS-7) MIUS TECHNOLOGY EVALUATION: LITHIUM BROMIDE–WATER ABSORPTION REFRIGERATION. Payne, H. R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 32p. Dep. NTIS $4.00.

Air conditioning by absorption refrigeration that utilizes heat recovered from engines and from incineration of solid waste is a utility service that can be included in a MIUS. This report reviews the suitability of lithium bromide–water absorption refrigeration for such an application. Types and sizes of units manufactured and their availability are discussed. Single-effect lithium bromide–water absorption systems are available from domestic manufacturers, and double-effect systems will probably be available in the near future. Capital and operation and maintenance costs are given for single-effect absorption-refrigeration systems. Where waste heat is available from electric power generation, a total energy system will use less fuel than a conventional system supplying electric power and using compressive refrigeration over a wide range of conditions. Fuel consumption comparisons are made between total energy and conventional systems providing the same service. (auth)

20412 (ORNL-TM-3021) PRELIMINARY INVESTIGATION DESALTING OF GEOTHERMAL BRINES IN THE IMPERIAL VALLEY OF CALIFORNIA. Spiewak, I.; Hise, E. C.; Reed, S. A.; Thompson, S. A. (Oak Ridge National Lab., Tenn. (USA)). 4 Mar 1970. Contract W-7405-eng-26. 46p. Dep. NTIS $4.50.

The Imperial Valley Project is an applied research program to provide geologic, hydrologic, engineering, and economic information necessary for development of the geothermal resources of the delta of the lower Colorado River. It is suggested that a desalting pilot plant be associated with the project to develop an economic desalting process if 2 to 3% geothermal brine is produced. The process will be unconventional in that waste heat must be rejected to atmosphere in wet or dry cooling towers. The presence of large amounts of CO_2, H_2S, and silica will require gas removal and silica-scale control equipment. The plant would process up to 75,000 gallons of brine per day. (MCW)

20413 (ORNL-TM-4135) EVAPORATIVE HEAT TRANSFER IN VERTICAL TUBES AT GEOTHERMAL BRINE CONDITIONS: A PRELIMINARY INVESTIGATION. Harley, P. H.; Eissenberg, D. M. (Oak Ridge National Lab., Tenn. (USA)). Jun 1973. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

Overall heat-transfer coefficients were obtained in a single-tube loop for a smooth tube and two fluted tubes proposed for use in a geothermal brine upflow VTE pilot plant. Tests were run at steam temperatures from 250 to 390°F, flow rates of 0.5 to 2.5 gpm, and steam to brine ΔTs of 10 to 30°F using demineralized water and 3% NaCl solutions. In each case the liquid entering the tube flashed through a ΔT equal to the steam–brine ΔT. The tubes tested were a ¾-in. smooth stainless steel tube, a 1-in. double-fluted CuNi tube, and a ⅛-in. double-fluted Al brass tube. Average heat transfer coefficients using 3% NaCl were as follows: for the stainless steel tube, 550 Btu/hr/°F/ft² at 250 to 765 at 390°F; for the CuNi tube, 2000 at 250 to 2600 at 390°F; for the aluminum brass tube, 1750 at 250° to about 2650 at 390°F. Flow rate and ΔT, in general, had only small effects on the coefficients. (auth)

20414 (ORNL-TM-4443, pp vp Paper 4) MAINTS: NEAR OPTIMAL UTILITY MAINTENANCE SCHEDULER PROGRAM. Walters, D. H. (Tennessee Valley Authority, Chattanooga); Howard, D. T.; Rees, F. Jan 1974.

From nuclear utilities planning methods symposium; Chattanooga, Tennessee (16 Jan 1974).

In collection of papers presented at the nuclear utilities planning methods symposium.

A computer program for generating maintenance schedules for fossil generation facilities is presented. A summary of the optimization algorithm which makes use of penalty factors in the selection of a schedule is included. The program also recognizes system reliability, regional security, and manpower constraints. Examples of some of the inputs and outputs for the program are also included. 6 references. (auth)

20415 (ORO-4507-1) PLANNING CRITERIA RELATIVE TO A NATIONAL RDT AND E PROGRAM DIRECTED TO THE ENHANCED RECOVERY OF CRUDE OIL AND NATURAL GAS. Final Report. (Gulf Universities Research Consortium, Galveston, Tex. (USA)). 30 Nov 1973. Contract AT(4C-1)-4507. 63p. (GURC-130). Dep. NTIS $5.45.

Enhanced recovery methods, problems, prospects, and status of methods under development and/or testing are summarized from data, forecasts, estimates, and opinions of 36 oil and gas production research, forecasting, and operating engineers. The industry investigation was conducted to determine the extent to which possible price increases would result in increased production and reserves of domestic crude oil and natural gas through the application of enhanced (non-conventional) recovery methods; the probable benefits to be derived from a federally supported, or partially supported, research and development program concerning the enhanced recovery of crude oil and natural gas as a possible component of a national energy program; and the definition of the general character, content, time, and cost of such a program. The conference conclusions and recommendations are enumerated. (MCW)

20416 (PB-224018) POTENTIAL ONSHORE EFFECTS OF DEEPWATER OIL TERMINAL-RELATED INDUSTRIAL DEVELOPMENT. Volume I. Part One. Executive Summary. Final Report. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Sep 1973. vp. NTIS.

An assessment was made of the onshore, or secondary, effects of deepwater terminal development on each of five areas (Machias, Maine; the vicinity of Sandy Hook, New Jersey; the Delaware Bay, New Jersey; Grand Isle, Louisiana; and Freeport, Texas) selected as terminal locations. The relative suitability of each area as a terminal site is affected by the relative impacts of a terminal on the area, including the additional industrial development, production, employment, air and water pollution, land use, population changes, etc., resulting from terminal development. The terminal impacts are related to the normal cumulative effects of growth processes on various individual areas and regions in order to illustrate their apparent capacity to accommodate terminal-related growth. (NTIS)

20417 (PB-224019) POTENTIAL ONSHORE EFFECTS OF DEEPWATER OIL TERMINAL-RELATED INDUSTRIAL DEVELOPMENT. Volume II. Part Two. Mid-Atlantic Region. Part Three. Maine. Final Report. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Sep 1973. vp. NTIS.

An assessment was made of the onshore, or secondary, effects of deepwater terminal development of the Mid-Atlantic region and on Maine, in particular, in the vicinity of Sandy Hook, N. J., in Delaware Bay, N. J., and at Machias, Me. The relative suitability of each area as a terminal site is affected by the relative impacts of a terminal on the area, including the additional industrial development, production, employment, air and water pollution, land use, population changes, etc., resulting from terminal development. (NTIS)

20418 (PB-224020) POTENTIAL ONSHORE EFFECTS OF DEEPWATER OIL TERMINAL-RELATED INDUSTRIAL DEVELOPMENT. Volume III. Part Four. Gulf Coast Region. Final Report. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Sep 1973. vp. NTIS.

An assessment was made of the onshore, or secondary, effects of deepwater terminal development on the Gulf Coast region, in particular, in the areas of Grand Isle, Louisiana, and Freeport, Texas. The relative suitability of each area as a terminal site is affected by the relative impacts of a terminal on the area, including the additional industrial development, production, employment, air and water pollution, land use, population changes, etc., resulting from terminal development. (NTIS)

20419 (PB-224021) POTENTIAL ONSHORE EFFECTS OF DEEPWATER OIL TERMINAL-RELATED INDUSTRIAL DEVELOPMENT. Volume IV. Part Five. Appendices. Final Report.

(Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Sep 1973. vp. NTIS.

The Appendices contain information and data pertinent to each area study. The Appendices are as follows: I. The Petrochemical Industry; II. United States Crude Oil Imports and Refining; III. Economic Methodology; IV. Environmental Methodology. (NTIS)

20420 (SLA-74-6007) COMBINED DETERMINATION OF THE THERMAL CHARACTERISTICS OF SOLID FUEL DURING HIGH-TEMPERATURE PYROLYSIS. Agroskin, A. A.; Goncharov, E. I.; Lovetskii, L. V. Translated from Khim. Tverd. Topl.; No. 4, 3-12 (1968). 14p. Dep. NTIS $3.00.

A method was developed for determining the thermal characteristics of solid fuel during pyrolysis. Analysis shows that the maximum error in the determination of the thermal diffusivity of coals by this method does not exceed ±3%, and in the case of thermal conductivity, the maximum error does not exceed ±4%. The heat effect of the pyrolysis reactions of coal exerts a substantial effect on its thermal conductivity and thermal diffusivity. The effective thermal diffusivity of anthracite varies along a curve with a minimum at 580° and a maximum at 725°C. The effective thermal diffusivity of poorly caking coal (Polysaevskaya mine) at first decreases with temperature and reaches a minimum at 475°, sharply increasing with further heating to 800°C. The true thermal diffusivity of this coal varies little with temperature. The true thermal conductivity of both samples increases linearly with temperature but, in the case of anthracite, the absolute values are much higher. (MCW)

20421 (UCID-16437) SHALLOW SOLAR POND SCHEME. Performance Assessment of a Model System. Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Oct 1973. Contract W-7405-eng-48. 82p. Dep. NTIS $6.25.

The division of energy among the various competing processes is discussed in the sequence from the collection of the solar flux, to the production of electrical power at a "busbar output" for the Shallow Solar Pond scheme. The solar collector utilizes shallow flowing water to transfer thermal energy to a hot water reservoir (at ~95°C). Several layers of plastic sheet cover the collection area to suppress heat losses. A Rankine Cycle thermodynamic system converts part of the heat energy to shaft work and thence to electricity. It would utilize a Freon gas turbine, along with evaporator, condenser and pressurizing pump; the rejected heat would be removed by an evaporation pond (at ~25°C). The fiducial system used for this analysis is assumed to have an area of 1 km^2. It would figuratively deliver an output of 8½ MW; its mean efficiency for the reference input is 2.8%. The reference operating point corresponds to equinoctial noon, 33°N lat. (No attempt was made to include a summer–winter optimization). The various losses and power expenses are summarized. (MCW)

20422 (Y-1922) REPRODUCIBILITY AND THERMAL STABILITY OF COAL-TAR PITCH. Smith, W. E.; Horne, O. J.; Napier, B. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1 Feb 1974. Contract W-7405-eng-26. 15p. Dep. NTIS $4.00.

Two aspects of a coal-tar pitch were studied: (1) reproducibility of the properties of as-received pitch as a function of the sampling period, and (2) changes in the properties that occur on heating the pitch for extended periods at elevated temperature. Reproducibility studies were conducted on twelve samples which had sampling histories that divided them into two groups of six samples each. Data indicated little variability of properties within a sample group, but significant variability between the two groups. A single lot of coal-tar pitch was analyzed as a function of residence time in an impregnator at 235°C. Properties reflecting increases in molecular size underwent gradual changes with increasing heating time, but the overall changes after 88 days did not appreciably alter the properties or utility of the pitch. (auth)

20423 PROGRESS IN UTILIZATION OF SOLAR ENERGY. Gupta, C. P.; Mehrota, R. K. (Univ. of Roorkee, India). J. Inst. Eng. (India); 53: No. 1, 13-27(1972).

The specific progress of solar energy utilization and its advantages are discussed. (27 references.) (Indian Sci. Abstr.)

20424 WHO BELONGS TO WHOM IN THE GERMAN NUCLEAR INDUSTRY? Solfrian, W. (Bonnenberg und Drescher Ingenieurgesellschaft mbH, Juelich, Ger.). Atomwirt., Atomtech.; 18: No. 12, 570-573(Dec 1973). (In German).

With the break-through of nuclear power plants for economic energy supply and after severe structural changes on the German market, a grouping of nuclear industry has formed, which will probably remain fixed for a longer period. In a series of four sequences, the shares and involvements in the German nuclear industry are shown by diagrams. The first sequence deals with those firms delivering turnkey nuclear power plants as well as steel and prestressed concrete pressure vessels. (GE)

20425 ELECTRICITY FOR TOMORROW. Engel, C. (Vereinigung Deutscher Elektrizitaetswerke e.V., Frankfurt am Main). Oel; 11: No. 2, 47-51(1973). (In German).

The electric power producing industry continues to expand at a dramatic pace and is concerned about the future availability of fuels and development of the prices. Starting from the present situation, the article discusses the shifts to be expected in the relative importance of the various types of power plants and in the shares that the sources of primary energy will contribute to keep this important sector of industry supplied. (GE)

20426 ROLE OF PLANT CONSTRUCTION IN THE EXPLOITATION OF NEW SOURCES OF ENERGY AND RAW MATERIALS. Klapp, E. U. (Technische Univ., Clausthal, Ger.). Chem.-Ing.-Tech.; 45: No. 19, 1155-1163(1973). (In German).

From European meeting on chemical engineering and ACHEMA congress, Frankfurt am Main, Germany (20 Jun 1973).

The incessant exploration of new sources of energy and raw materials will present new problems and augment production possibilities for construction and fabrication of equipment and chemical plant design. From the manufacturer's point of view this requires increased development efforts and systematic product planning as well as a shift of emphasis from routine production to the realization of complete process steps and solutions to problems. On the basis of detailed inquiries and market observations and research, a prognosis of specific cost factors in the fabrication of apparatus and plants, inter alia, for the petroleum industry, marine mining, seawater desalination, and nuclear power plants was attempted. These forecasts refer to the time between 1970 and 1980; the various numerical data were averaged from several sources. The prospects for marine mining including seawater desalination, the petroleum industry, and nuclear reactor technology, promise expansion opportunities in the manufacture of equipment and plant. (GE)

20427 MATHEMATICAL MODELLING OF THE LIMESTONE–SULFUR DIOXIDE REACTION IN A FLUIDIZED-BED COMBUSTOR. Bethell, F. V.; Gill, D. W.; Morgan, B. B. (British Coal Utilization Research Association, Stoke Orchard, Eng.). Fuel; 52: No. 2, 121-127(Apr 1973).

The processes in a fluidized-bed combustor are analyzed, and equations are written to express the absorption rate of sulfur dioxide by limestone in admixture with the fuel feed. The procedure adopted for solution of the equations is described, and some of the results predicted by the model are briefly referred to, with comparisons between the predicted and measured retentions for two coal-fired combustors. These are in good agreement for a dolomite and a reactive limestone; but for a second, less-reactive, limestone the predicted retentions are too low, and possible reasons for this are suggested. (auth)

20428 CHANGES IN STATE OF COMBINATION OF INORGANIC CONSTITUENTS DURING CARBONIZATION OF VICTORIAN BROWN COAL. Murray, J. B. (State Electricity Commission of Victoria, Melbourne). Fuel; 52: No. 2, 105-111(Apr 1973).

The inorganic constituents of low-rank Victorian brown coal, mainly present as inherent inorganic combinations attached to the coal molecule, are different from the minerals present in higher-rank coals. Changes in the state of combination of the inorganics in the chars of these coals were studied by determining the minerals formed when chars are prepared at various temperatures. It is shown that, when brown coals containing inorganic carboxylates are carbonized, the reactive functional groups present will begin to decompose below 400°C and their decomposition is completed by 600°C. The inorganic elements released will form mineral combinations depending on the carbonizing temperature and the reduction potential of the metal. Sodium carbonate, calcium oxide, magnesium oxide (periclase), and iron oxide (magnetite) are usually the chief minerals that may be formed. Mineral constituents present in the original coal may also change during carbonization. As the temperature increases, hydrated oxides of iron, clay, and aluminium will lose water of crystallization and become dehydrated, forming magnetite, dried clay, and alumina. Pyrite will lose up to half its sulfur at 400 to 450°C. If the carbonization temperature is over 600°C, metallic iron may be formed from the magnetite, and sodium chloride (and later sodium carbonate) will volatilize. Quartz remains unaltered. (auth)

20429 INCREASE IN EXTRACTABILITY OF BITUMINOUS COALS CAUSED BY FRIEDEL–CRAFTS ACYLATION. Hodek, W.; Koelling, G. (Bergbau-Forschung GmbH, Essen). Fuel; 52: No. 3, 220-225(Jul 1973).

Four bituminous coals of different rank were acylated with aliphatic acyl chlorides using Friedel–Crafts catalysts. A dry steam coal and a coking coal showed particularly good reactivity, five acyl groups being inserted per 100 carbon atoms. Compared

with the initial coal, the acylated coals were distinguished by considerably higher amounts soluble in pyridine and other solvents. 85% of the coking and dry steam coal substance became soluble when acylated with lauric acid chloride or acyl chlorides having still longer chains. The extractability of the coals after acylation depends on the chain length of the inserted acyl groups. To all appearances, the extracts are dispersed in the solution in the form of molecules. It is supposed that the good extractability of acylated coals is mainly due to depolymerization of the coal substance during acylation, disappearance of hydrogen bridges by esterification of the phenolic OH groups, and neutralization of intermolecular forces between the aromatic structures by insertion of long-chain substituents. (auth)

20430 FLASH PYROLYSIS OF COAL: EFFECT OF NITROGEN, ARGON, AND OTHER ATMOSPHERES IN INCREASING OLEFIN CONCENTRATION AND ITS SIGNIFICANCE ON THE MECHANISM OF COAL PYROLYSIS. Banerjee, N. N.; Murty, G. S.; Rao, H. S.; Lahiri, A. (Central Fuel Research Inst., Dhanbad, India). Fuel; 52: No. 3, 168-170(Jul 1973).

Samples of three Indian coals, of widely differing origin and rank, were subjected to flash pyrolysis at a temperature of about 1150°C for 30 sec in vacuo, and under atmospheres of nitrogen, argon, ammonia, and perdeuterobenzene. The gaseous products of the pyrolyses were analysed by ir and mass spectroscopy and by gas chromatography. Observed variations in gas compositions are discussed relative to the possible mode of influence by the pyrolytic atmospheres. It would appear that the pyrolytic atmosphere is an important factor in determining the composition of the pyrolysis products; the influence of nitrogen, argon and perdeuterobenzene is a physical one, leading especially to higher yields of olefins. (auth)

20431 CATALYTIC DEHYDROGENATION OF COAL. Part 7. The Effect of Some Catalyst Variables. Reggel, L.; Wender, I.; Raymond, R. (Pittsburgh Energy Research Center). Fuel; 52: No. 3, 162-163(Jul 1973).

When vitrinite is catalytically dehydrogenated in the presence of phenanthridine as vehicle, the yield of hydrogen is not greatly influenced by the catalyst support or the concentration of metal on the support. The metal used has a large effect, palladium giving the highest yield of hydrogen. (auth)

20432 KINETICS OF CONVERSION OF TETRALIN DURING HYDROGENATION OF COAL. Potgieter, H. G. J. (Univ. of Potchefstroom, S. Afr.). Fuel; 52: No. 2, 134-137(Apr 1973).

Tetralin has been considered a reasonably good hydrogen donor for the hydrogenation of coal, but in the literature little attention has been given to the kinetics of its conversion. In this paper it is suggested that the conversion of tetralin, mainly to naphthalene, may be either a reversible or a non-reversible reaction depending on the catalyst employed. It is further concluded that stannous chloride, though considered one of the best coal hydrogenation catalysts, is inferior to cobalt oxide when the side reaction tetralin → decahydronaphthalenes and the rate of dehydrogenation of tetralin are considered. (auth)

20433 FORMATION OF ANISOTROPIC MESOPHASE FROM VARIOUS CARBONACEOUS MATERIALS IN EARLY STAGES OF CARBONIZATION. Sanada, Y.; Furuta, T.; Kimura, H.; Honda, H. (National Research Inst. for Pollution and Resources, Kawaguchi, Japan). Fuel; 52: No. 2, 143-148(Apr 1973).

The low-temperature carbonization of pitches, reduced crudes, synthetic polymers, and various ranks of coals has been studied by polarized-light microscopy, x-ray diffraction, and solvent extraction. Formation of anisotropic mesophase is a function of heat-treatment temperature and residence time for those materials that pass through a fusion stage in the temperature range from 350 to 500°C. The nucleation of spherules from the pitches and reduced crude during low-temperature carbonization is proportional to the amount of β-resin, which is benzene-insoluble and quinoline-soluble, and the rate of its formation. Addition of sulfur to the pitch turns the texture of mesophase spherules to that of a fine mosaic when the mixtures are heat treated in the temperature range of 350 to 500°C. Methylation of the hydroxyl groups in 3,5-dimethyl phenol formaldehyde resin, by reacting with dimethyl sulphate, gives an anisotropic texture that consists actually of tiny spherules together with parent matrix; the original resin gives the typical mosaic texture. The molecular forces in the decomposing carbonaceous materials during low-temperature carbonization are among important factors governing the mesophase transformation. A common mechanism of formation of various anisotropic textures can explain the behavior of coal-cokes, pitch, crudes, and polymers. (auth)

20434 JAPAN PREPARES HVDC TECHNIQUE TO MEET DOMESTIC NEED. Horiuchi, T. (Tokyo Shibaura Electric Co.); Kato, Y. Energy Int.; 11: No. 1, 13-14(Jan 1974).

The eastern and western sections of Japan have been interconnected since 1965 through a hvdc frequency converting station located at Sakuma with a converting capacity of 300 MW. Now plans are made to connect the two islands with a second frequency converter at the border of the first system. Two 125-kV 37.5-MW three-phase bridge thyristor converters were installed at the Sakuma Testing Station in 1970 and have established confidence in the design of thyristor valves for hvdc power transmission. (MCW)

20435 SYNTHETIC FUELS: WILL GOVERNMENT LEND THE OIL INDUSTRY A HAND. Gillette, R. Science; 183: No. 4125, 641-643(15 Feb 1974).

The United States possesses immense deposits of coal and oil shale. The combined effects of government and industry research, and the exploding prices of conventional petroleum make synthetic oil and gas within a comfortable profit margin. At a shale oil plant, the production costs are about the same as the current price of conventional oil in the USA. Government funding is not necessary, since estimated costs of a shale or gasification plant are not much higher than nuclear power plants that are being built privately. The AEC concludes that a massive synthetic fuel program cannot now be justified, but calls for a "Synthetic Fuels Pioneer Program." (auth)

20436 UHV OR HVDC. That is the Question. Jeffs, E.; Codling, N. Energy Int.; 11: No. 1, 9-12(Jan 1974).

The merits of hvdc and uhv ac transmission systems were discussed at an international conference of Electrical Engineers in London, Nov. 1973. Environmental aspects are discussed in relation to increased power-transmission ratings. Within the next decades, power generation will be concentrated in huge blocks of power between 10 to 20 GW in size, and transmission rights-of-way will be restricted. What the transformer has done for ac distribution the solid state rectifier might do for dc transmission. The stability criterion on an interconnected system, the use of shunt capacitors and saturable reactors, the possibilities of superconducting cables, and uhv are discussed. Economic aspects of future power transmission systems are outlined. (MCW)

20437 UNCATALYZED HYDROGENATION OF COAL. Liebenberg, B. J.; Potgieter, H. G. J. (Univ. of Potchefstroom, S. Afr.). Fuel; 52: No. 2, 130-133(Apr 1973).

The uncatalyzed hydrogenation of a bituminous coal in a batch reactor with tetralin as solvent has been investigated. This investigation differs from others reported in the literature mainly in the sampling methods employed. Because of the methods previously employed, effects of heating to reaction temperature and cooling to ambient conditions were not excluded; this complicated an investigation into the kinetics of coal hydrogenation. Samples were withdrawn from the reactor after reaction temperature and pressure were reached. It is concluded that simple series or parallel reactions suggested in the literature for the hydrogenation of coal are oversimplified mechanisms. (auth)

20438 COMPOUND ISOLATION FROM BROWN COAL BY LOW-TEMPERATURE EVACUATION. Swann, P. D.; Harris, J. A.; Siemon, S. R.; Evans, D. G. (Univ. of Melbourne). Fuel; 52: No. 2, 154-155(Apr 1973).

The compound 2,6-di-t-butyl-4-methylphenol was isolated from brown coal during low-temperature evacuation at 35°C. This discovery is important to all oxidation, hydration, and distillation studies on brown coal and might indicate that the compound is present free in the brown coal and not formed by decomposition of a larger molecule. The method used for removing the water from the coal was that used by Allardice and Evans, namely vacuum desorption at the oxidation temperature of 35°C. Bed-moist brown coal that had been kept at all times under water was ground under water to −100 +200-mesh BS. It was then suspended in a bucket from a quartz spring in a water-jacketed glass reactor and vacuum dried. Oxidation was performed by pure molecular oxygen at a pressure of 760 mm Hg and the extent of oxidation was measured by the weight increase of the coal that was followed by a cathetometer. Results show that the amount of oxidation, as measured by the weight increase of the coal, was affected by the degree of drying. When the coal was evacuated to a pressure of 100 μm Hg, the amount of oxidation was far greater than when the coal was evacuated to a pressure of 10 μm Hg. A possible explanation was that volatile compounds were being removed from the coal when evacuation at 35°C was carried out at pressures lower than 100 μm Hg. (MCW)

20439 ENERGY AND FOREIGN POLICY. Hearings Before the Committee on Foreign Relations, United States Senate, Ninety-Third Congress, First Session on the Implications of the Current Energy Problem for United States Foreign Policy, May 30 and

31, 1973. Washington, DC; Committee on Foreign Relations (1974). 240p. GPO.

A general suvery of the energy problem and its implication for American foreign policy was provided at the committee hearings by well-qualified specialists from within and outside the Government. The Arab oil-producing states were thinking about the leverage of their oil wealth as a weapon in their dispute with Israel and in their related dealings with the great powers even at this time in May, 1973. The energy requirement of the United States in relation to the Persian Gulf was the theme of the hearings. (MCW)

20440 OSMOTIC PUMP. Levenspiel, O. (Oregon State Univ., Corvallis); de Nevers, N. Science; 183: No. 4121, 157-160(18 Jan 1974).

Descriptions are given of an osmotic pump that would produce fresh water from seawater at no expenditure of energy and an osmotic power plant that would extract energy from the ocean. The scientific basis of these devices and their prospects as engineering devices are analyzed. Three analyses are made in various cases: the equilibrium ocean, where the salt concentration and density change with depth; the uniform ocean, where the ratio of salt to water stays constant, but the density changes with depth; and the real ocean, which is neither at equilibrium nor uniform. (MCW)

20441 OUTLOOK FOR MINE AND PLANT EXPANSION: SOLID NOW, BUT AN UNCERTAIN ROAD AHEAD. White, L. Eng. Mining J.; 175: No. 1, 69-80(Jan 1974).

In 1973, metals prices were generally at or near record high levels, and mining companies throughout the world were pushing to complete a large number of new mines and plants. The future is clouded with energy shortages, the possibility of a supply-induced recession in the world economy, environmentalist pressures, and shortages in skilled labor. Fuel and power shortages have begun to affect metals production in the USA, Japan, and Western Europe. An extensive survey is presented of mine and plant expansion around the world for such commodities as Al, Cu, iron ore, Ni, Mo, Nb, Cr, V, W, Pb, Zn, Au, Pt, Ag, Re, Tl, Sb, Ga, Hg, Sn, Si, U, asbestos, fluorspar, and phosphate. (MCW)

20442 LAW NEEDED FOR GEOTHERMAL ENERGY. Fannin, P. Pub. Util. Fortn.; 93: No. 3, 15-17(31 Jan 1974).

The Geothermal Energy Act of 1973, S 2465, was incorporated into the comprehensive Energy Research and Development Policy Act, passing the Senate on Dec. 7, 1973. The bill provides a mobilization of both private and governmental efforts to utilize resources that are economically and commercially useful in meeting the energy needs. Key elements include a federal loan guaranty program, use of space and nuclear development agencies to further geothermal research, and a plan to develop resources on federal lands. (MCW)

20443 FIRST PLASMA POWER PLANT IN OPERATION. Sheindlyn, A. (Inst. of High Temperatures, Moscow). Curr. Eng. Pract.; 15: No. 4, 14(Oct 1972).

The principle on which MHD generators are based is explained in brief. The economic and other advantages of using plasma as the conductor in an MHD generator for the production of electricity is brought out by comparing this technique with other conventional ones. It is reported that power plants employing this method can turn 50 to 60% of the heat consumed into electricity, i.e., 50% more output with the same input of fuel, as compared to the other methods. The working of the U-25 power plant in the USSR, which operates on the above principle, is described. A brief mention is made of the success of this plant which has led the USSR to launch a future plan of having many more such MHD generators for coping with the sharp power-consumption peaks in power grids in the country. (INIS)

20444 ENERGY AND THE CAPITAL MARKETS. Saul, R. S. Pub. Util. Fortn.; 93: No. 3, 33-38(31 Jan 1974).

The urgency for the search for new sources of capital and lower costs of financing for the investor-owned utilities is discussed. The external financing requirements of the electric utilities will jump from $10 billion in 1973 to $14 billion in 1977. Utility financing is now more complex. Utilities may have to finance nuclear fuel cores, coal mines, pipelines, storage terminals, and ships, as well as equipment to control pollution connected with utilities. The maintenance of current earnings levels will be a function of rate relief and this is the only solution to the industry's ability to raise equity capital. (MCW)

20445 PRACTICAL APPLICATION OF GEOTHERMAL STEAM. Finney, J. P. Pub. Util. Fortn.; 93: No. 3, 18-20 (31 Jan 1974).

The Geysers power plant, 80 miles north of San Francisco, is the largest geothermal installation in the world and the only such system in the United States. Ten units are now in operation producing 396,000 kW, using steam piped directly from wells tapping a dry-steam reservoir. A description of the system is given. It appears that geothermal development in the USA will be confined to the West, and exploration must be accompanied by more research. The role of government and industry in geothermal development is explained. It is estimated that by the year 2000, 6 million kilowatts of geothermal energy might be in operation in the United States. (MCW)

20446 POWER PLANT SITING: ITS IMPACT ON SYSTEM PLANNING AND THE ENVIRONMENT. 1971 Summer Meeting of IEEE, Portland, Oregon, July 22, 1972. New York; Institute of Electrical and Electronics Engineers (1971). 28p. (CONF-710742-1). $3.00.

Separate abstracts were prepared for the three papers presented at the third session of the Power Engineering Society, Portland, Oregon, July, 1971. (MCW).

For abstracts of individual papers see: 20447–20449.

20447 PLANT SITING: A KEYSTONE ELEMENT IN THE ARCH OF SYSTEM PLANNING AND ENVIRONMENTAL CONTROL. Sporn, P. pp 3-12 of Power Plant Siting: Its Impact on System Planning and the Environment. New York; Inst. of Electrical and Electronics Engineers (1971).

From meeting on power plant siting, its impact on system planning and the environment; Portland, Oregon, USA (22 Jul 1971). See CONF-710742-1).

The development of Con Edison from the capacity of 792 kW in 1882 to a capacity of 8,273 MW within the confines of New York City in 1967 is followed. System generation and transmission diagrams of three integrated systems are discussed, namely the New England Electric System, the Middle South Utilities System, and the American Electric Power System. Plant siting has a large effect on system planning, but system planning has an enormous effect on plant siting. (MCW)

20448 POWER SYSTEM FACILITIES: THEIR IMPACT UPON ECOLOGY. Berry, P. S. pp 13-16 of Power Plant Siting: Its Impact on System Planning and the Environment. New York; Inst. of Electrical and Electronics Engineers (1971).

From meeting on power plant siting, its impact on system planning and the environment; Portland, Oregon, USA (22 Jul 1971). See CONF-710742-1.

The conservationist's concept of growth is discussed in view of its need and its impact on ecology; the real need when confronted with the demand for additional power plants or oil is discussed. An economy based on production for consumption's sake must be questioned. Conservation is concerned essentially with the quality of life, measured in terms of quieter, noncommercial and essentially nonmaterialistic values. The author feels that there are plenty of legitimate profits to be made, not just in cleaning up the pollution but in providing those necessary and continuing services to industry and communities that will permit the most conservative use of our natural resources in the future. (MCW)

20449 ENERGY AND THE ENVIRONMENT: THE DILEMMA OF THE STATE UTILITY REGULATOR. Ward, W. F. pp 17-19 of Power Plant Siting: Its Impact on System Planning and the Environment. New York; Inst. of Electrical and Electronics Engineers (1971).

From meeting on power plant siting, its impact on system planning and the environment; Portland, Oregon, USA (22 Jul 1971). See CONF-710742-1.

The state utility regulator is charged with the protection and enhancement of the quality of the state's waters, land, and air without specific mandates stating this order in these terms. Some experiences of the utility regulator in Michigan are reviewed and include warnings that energy can no longer be taken for granted in a finite world and will not continually be cheaply available for all current and projected demands. Regulators have to stand by and watch environmentally oriented invervenors utilize ponderous procedures, often neglecting important factors. The utility industry is admonished for spending more for advertising than for research and development. (MCW)

20450 GEOTHERMAL RESOURCES OF THE NORTHERN GULF OF MEXICO BASIN. Jones, P. H. (Geological Survey, Baton Rouge, LA). Geothermics; No. Special Issue, 14-26 (1970).

Published geothermal gradient maps for the northern Gulf of Mexico basin indicate little or no potential for the development of geothermal resources. Results of deep drilling from 4000 to 7000 meters or more during the past decade however, define very sharp increases in geothermal gradient that are associated with the occurrence of abnormally high interstitial

fluid pressure. Bounded by regional growth faults along the landward margin of the Gulf Basin, the geopressured zone extends some 1300 km from the Rio Grande to the mouth of the Mississippi River. Gulfward, it extends to an unknown distance across the Continental Shelf. Within geopressured deposits, geothermal gradients range upwards to 100°C/km, being greatest within and immediately below the depth interval in which the maximum pressure gradient change occurs. The 120°C isogeotherm ranges from about 2500 to 5000 m below sea level, and conforms in a general way with depth of occurrence of the top of the geopressured zone. Measured geostatic ratios range upward to 0.97: the maximum observed temperature is 273°C, at a depth of 5859 m. Dehydration of montmorillonite, which comprises 60 to 80% of clay deposited in the Northern Gulf Basin during the Neogene, occurs at depths where temperature exceeds about 80°C, and is generally complete at depths where temperature exceeds 120°C. This process converts intracrystalline and bound water to free pore water, the volume produced being roughly equivalent to half the volume of montmorillonite so altered. Produced water is fresh, and has low viscosity and density. Sand-bed aquifers of deltaic, longshore, or marine origin form excellent avenues for drainage of geopressured deposits by wells, each of which may yield 10,000 m^3 or more of superheated water per day from reservoirs having pressures up to 1000 bars at depths greater than 5000 m. (46 references) (auth)

20451 REFRIGERATION TURBOCOMPRESSORS FOR BASE-LOAD LNG PLANTS. Naegeli, J. P. (BST Brown Boveri–Sulzer Turbomachinery Ltd., Winterthur, Switzerland). Sulzer Tech. Rev.; 55: No. 4, 213-224(1973).

From twenty-seventh ASME Petroleum Division conference, New Orleans, LA (1972).

Various mixed refrigerant liquefaction cycles are compared from the refrigerant compressor manufacturer's view point, highlighting the significant considerations applicable in matching machinery and cycles. The compressor technology for high power liquefaction loops is evaluated, concluding that 300 MW modules could be built with the machinery available. Criteria currently applied to rotor dynamics and shaft vibration levels are critically examined. The danger of blade vibration is discussed and the relative merits of solid and gear-type shaft couplings are compared. A few operational considerations conclude the paper. (auth)

20452 THERMODYNAMIC CYCLES OF CARBON DIOXIDE PLANT WITH AN ADDITIONAL TURBINE AFTER THE REGENERATOR. Gokhstein, D. P.; Taubman, E. I.; Konyaeva, G. P. (Odessa Polytechnic Inst.). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 3, 122-123(Mar 1973).

Translated from Teploenergetika; 20: No. 3, 86-87(Mar 1973).

Further improvement in CO_2 as a working medium in gas–liquid cycles to obtain higher efficiency gain in power plants was investigated. The CO_2 cycle is only economic with high inlet turbine pressures and a low condensation temperature. Further efficiency is gained if the working medium after being cooled in the regenerator, instead of passing into a cooler, passes into a turbine and then to a condenser or cooler. Efficiency calculations were made for the simple gas-liquid cycle, cycle with superposed turbine, cycle with combined regeneration, and with gas cycle. An investigation was also made into the effect of the temperature head at the cold end of the regenerator on the thermodynamic efficiency of the cycles for an initial cycle temperature of 813 K. (MCW)

20453 PART PLAYED BY ATOMIC AND MOLECULAR OXYGEN IN THE FORMATION OF SO_3 WHEN BURNING NATURAL GAS OF HIGH SULPHUR CONTENT. Skorik, L. D.; Tsirul'nikov, L. M. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 3, 115-117(Mar 1973).

Translated from Teploenergetika: 20: No. 3, 82-83(1973).

The combustion of high-sulfur fuels in furnaces of steam boilers produces SO_3 as a result of reactions between sulfur monoxide and molecular oxygen, sulfur dioxide and atomic oxygen in the high temperature zone of the flame, and the heterogeneous catalytic reaction between SO_2 and molecular oxygen. Calculations were made of the equilibrium states of the combustion products of high-sulfur natural gas to assess the role of atomic and molecular oxygen in the mechanism of SO_3 formation. Results are confirmed by previous testing. (MCW)

20454 PRODUCTION OF IRON WITH ELECTROLYTIC HYDROGEN THROUGH THE APPLICATION OF NUCLEAR ENERGY. Wortberg, E. J.; Block, F. R. (Technische Hochschule, Aachen). VDI (Ver. Deut. Ing.) Z.; 115: No. 16, 1275-1284(Nov 1973). (In German).

From the technological standpoint, the economical production of hydrogen through electrolysis does not cause any difficulties. It can be proven that iron may be reduced directly in the fluidized bed with hydrogen at a temperature of 800°C with a degree of reduction of up to 95%, without the appearance of the sticking effect. For the production process, a three-stage discontinuous fluidized-bed method is recommended. Environmentally favorable and competitive steel plants adjacent to iron ore ranges are feasible in the future with the availability of electrical energy and heat produced in nuclear reactors. (GE)

20455 ENERGY CONSUMPTION, A COMPARISON: NUCLEAR POWER FOR THE FUTURE. Sufficient Coal at High Prices. Ber. Inform. (Eur. Gemeinsch.); No. 15, 4-5(1972). (In German).

Numerical data are given concerning the increase in energy consumption from 1950 to 1969 in the most important countries, as well as estimates of the future energy consumption within the European Community. (INIS)

20456 GEOTHERMAL COOLING URGED FOR MANAGUA. Geotherm. Energy Mag.; 2: No. 1, 51(Jan 1974).

Geothermal resources in Managua, Nicaragua could serve as a source of heat for the city as it does in Reykjavik, Iceland. Direct use of Earth heat sources for air conditioning by a single heat-to-cold conversion process for the new city of Managua would cost only one-half as much as electric power. Injection of water under the ground to replace hot water and steam used by the cooling system should make the source last forever. (MCW)

20457 NONELECTRICAL USES OF GEOTHERMAL RESOURCES. Ogle, W. E. Geotherm. Energy Mag.; 2: No. 1, 32-33(Jan 1974).

Future energy demands in the United States indicate that by 1985 about 30% of the total energy use will be for non-electrical, non-transportation uses. This includes residential and commercial space heating, chemical processing, and other manufacturing processes. It appears that most of that 30% could be satisfied with geothermal energy. These same studies predict that about 35% of the U. S. energy consumption by 1985 will be used to produce electricity. These predictions indicate that the use of energy to supply electricity will increase out of proportion by 1985. By deductions, it is shown that geothermal energy could be used directly in place of electrical power. Every kilowatt furnished by geothermal heat could save 3 kW of some other form of energy. (MCW)

20458 LAWRENCE LIVERMORE LABORATORY. Geotherm. Energy Mag.; 2: No. 1, 26-31(Jan 1974).

The Livermore approach represents the first serious attempt to extract large-scale electrical energy from salty hot waters of a geothermal deposit. At the Geysers, relatively clean and dry naturally occurring steam is utilized. In New Zealand and Mexico, the steam component is separated from the brine and used to generate electricity. An effort will now be made to extract energy from the total brine mixture of steam, hot water, and salts from the Salton Sea Trough with the total flow method of geothermal energy generation. (MCW)

20459 GEOTHERMAL RESOURCES OF COLORADO. Pearl, R. H. (Colorado Geological Survey, Denver). Geotherm. Energy Mag.; 2: No. 1, 18-20(Jan 1974).

The U. S. Geological Survey lists Colorado as having no known geothermal resource areas. Several areas warrant investigation as possible geothermal areas. The San Luis Valley, a northern extension of the Rio Grande Rift Zone of New Mexico, is an area of anomalous heat flow values, 1.5 to 2.08 HFU. Around the western edge of this valley and extending into the Arkansas River Valley are numerous hot springs. (MCW)

20460 COAL AND THE PRESENT ENERGY SITUATION. Osborn, E. F. (Carnegie Institution of Washington, DC). Science; 183: No. 4124, 477-481(8 Feb 1974).

Coal is an energy resource that is in great abundance. The first step is to move immediately to replace the oil and gas used in electric generating plants with coal and to require that coal be used in fossil-fuel electric plants planned or under construction in the next few years. The technology to remove sulfur and particulates from the stack gases is at hand, and therefore environmental regulations can be met. Mining and transporting the required increased tonnages of coal are problems that can be met with appropriate incentives to the coal and transportation industries. Oil and gas from coal should be in significant commercial production in about a decade. Underground, or in situ, gasification of coal looks promising. Recoverable methane occurs in coal beds in the United States in an amount approximately equal to the total reserves of natural gas—about 260 trillion cubic feet. This large reserve of natural gas should be exploited as quickly as possible. (20 references) (MCW)

20461 FISSION ENERGY AND OTHER SOURCES OF ENERGY. Alfven, H. Bull. At. Sci.; 30: No. 1, 4-8(Jan 1974).

The energy problem was discussed at the Pugwash conference at Oxford in 1972. Recommendations of an international institute for the study of the scientific, technological, political, and economic aspects of energy problems in the whole world were presented. The major recommendation was directed toward increased research on how to make fission energy acceptable. An effort should be made to develop alternative energy sources that satisfy ecological demands. An analysis should be made to determine the real need for additional energy. (MCW)

20462 FUTURE TRENDS IN ENERGY SUPPLY. Hauser, L. G. Pub. Util. Fortn.; 93: No. 2, 24-32(17 Jan 1974).

Energy forecasts indicate a continuing growth rate in the consumption of energy in the USA economy. The energy source that is available domestically in the period 1974–2000 is graphically shown and indicates with proper planning that imported energy could be avoided. The resource base is identified as the quantity of energy that can be produced over a given period of time, rather than expressed as total resource base in the ground. The resources studied included coal, natural gas, petroleum, and uranium ores. Such actions as nuclear power plant moratoriums, banning space-heating electricity, the strip mining of coal, and delaying tactics in construction of new generating plants are the policies that precipitate a crisis. By utilizing present technology, about 70% of the present energy demands could be met by the use of electricity, thus reducing dependence on natural gas and oil. (MCW)

20463 LOW-SULFUR COAL: THE FASTEST GUM-UP IN THE WEST. Holyoak, R. H. Elec. Light Power, E/G Ed.; 52: No. 1, 33-35(Jan 1974).

Commonwealth Edison boilers were designed to use a high-rank, type-C bituminous coal from Illinois. The characteristics of the Illinois coal are given and compared to western coal, which is now being used. Illinois coal is not now acceptable in most of the system because of ordinances limiting sulfur and SO_2 discharges and lack of technology to reduce the sulfur content. Western coal is inferior to Illinois coal except in the area of sulfur content and, in some cases, ash content. Testing results are presented on Colstrip, Arch Mineral, and Decker coals and compared with the percent sulfur, Btu/lb heating value, percent reduction Btu, and percent moisture characteristics of the Illinois coal. Preparation, ash handling, water treatments, and combustion in cyclone-fired boilers are some of the problems discussed for western coal. The precipitators on the Commonwealth Edison system were upgraded to utilize the western coal. (MCW)

20464 LET'S BURN SOME RUBBER. Elec. Light Power, E/G Ed.; 52: No. 1, 36-37(Jan 1974).

A Lucas furnace system, a cyclonic furnace, may have applications in the utilities as a source of heat energy and municipal waste disposal. Some incinerators are operating in England, Australia, and at the Goodyear Tire and Rubber Company at Jackson, Michigan. A sludge burning furnace is being constructed in San Leanardo, California. The furnace is essentially a vertical domed cylinder with a rotating hearth at the bottom and an array of air jets and burners around the furnace wall. There is complete oxidation minimizing smoke, particulates, and off-gases. The process, using tires, is autothermic and the cyclone quickly builds temperatures to 2200°F. The furnace heat can produce ~100,000 lbs. steam/hr at 450°F as it consumes 500 tires/hr. The output is considered as only process steam, but its heat energy could be useful in multi-stage process systems. In this process, the tires may be fed whole, while previous methods have required shredding, etc. (MCW)

20465 U. S. ENERGY SELF-SUFFICIENCY: VAIN HOPE OR ATTAINABLE GOAL? Roddis, L. H. Jr. (Consolidated Edison Co. of New York, NY). Pub. Util. Fortn.; 93: No. 4, 24-27(14 Feb 1974).

The Arab oil embargo caused the precipitation of the fuel crisis, but the relief of this embargo is not a solution to the ever-approaching fuel problem. In attempting to attain U. S. energy self-sufficiency, four time frames are discussed. In the immediate year, conservation, allocation, and rationing should reduce the demand side. The second or near term in the 1970's must include increasing production of known wells, drilling in known regions such as Alaska, and finding ways to assure that known technologies of making clean-burning fuels from coal are applied at any cost. In the longer term to the year 2000, nuclear power and research and development for using coal, geothermal, and solar energy are necessary. In the very long term, development of nuclear fusion and the implementation of geothermal and solar energy are needed. (MCW)

20466 INTERLOCKING OIL: BIG OIL TIES WITH OTHER CORPORATIONS. Fritsch, A. J. (ed.). CSPI Oil Series. Washington, DC; Center for Science in the Public Interest (1974). 52p.

There are 460 interlocking directorates and advisory committee connections of eighteen large oil companies with well-known large corporations. There are 132 interlocks with banks; 31 with insurance; 12 with utility companies; 15 with transportation corporations; 46 affiliations with educational institutions; and 224 with manufacturing and distribution corporations. (MCW)

20467 ENERGY IN BRITAIN: SHOPPING FOR A NEW REACTOR. Hawkes, N. Science; 183: No. 4120, 57-59(11 Jan 1974).

The controversy in Great Britain over the type of reactor acceptable looms. Tentatively, the LWR is the type chosen for construction, but nuclear power safety has become the issue. With an increase in electric consumption, the Central Electricity Generating Board recommends the application of the LWR for use in Britain. All designs have been considered, but the LWR costs the least and since capital cost is the determining factor, would produce the cheapest electricity. The Magnox gas-cooled graphite-moderated reactor in which natural uranium is used has served well in Britain and has its supporters. (MCW)

20468 HEAT FLOW NEAR ORLANDO, FLORIDA AND ULVALDE, TEXAS DETERMINED FROM WELL CUTTINGS. King, W.; Simmons, G. (Massachusetts Inst. of Tech., Cambridge). Geothermics; 1: No. 4, 133-140(Dec 1972).

Heat flow was determined in a borehole near Orlando, Florida and another near Uvalde, Texas. Thermal conductivities in both boreholes were obtained by divided-bar measurements on rock discs and by needle-probe measurements on rock chips. For the needle-probe method, the rock chips were pulverized into powder, saturated with water, and the conductivity of the solid rock was obtained from the conductivity of the mixture by an empirical relationship. Divided-bar measurements for the Florida borehole indicate a heat flow of 0.92 ± .03 H.F.U., while needle-probe measurements on rock chips show a heat flow of 1.24 ± .06 H.F.U. The discrepancy is attributed to anisotropy of the sedimentary rocks penetrated by the borehole. Heat flow obtained from these two different methods of determining condictivity show good agreement in the Texas borehole. Divided-bar measurements indicate a heat flow of 1.08 ± .03 H.F.U., while the chip technique gives a value of 1.13 ± .03 H.F.U. (auth)

20469 FLOW IN GEOTHERMAL WELLS (AN ANALYTICAL STUDY). Tolivia, E. (Comision Federal de Electricidad, Mexico City). Geothermics; 1: No. 4, 141-145(Dec 1972).

The flow pattern in geothermal wells was determined from several flow, pressure, and temperature measurements in flowing wells. The procedure followed for the determination of the two-phase flow composition and the flow pattern is shown. A model is proposed for the mechanics of scale formation in the production casing of the wells, caused mainly by the silica-saturated fluid produced. The flow pattern for horizontal pipelines and the calculation for the pressure gradient using Dukler equations are presented. The calculated values are then compared with experimental values obtained in a 674-meter-long pipeline discharging a steam-water mixture. (auth)

20470 SCREENED CONDUCTORS FOR ALTERNATOR–STEP-UP TRANSFORMER LINKS IN LARGE THERMAL AND NUCLEAR POWER PLANTS. Nisol, R. (Society Simel, Paris). Indian J. Power River Valley Develop.; 23: No. 3, 89-92 (Mar 1973).

With the building of large thermal and nuclear power plants, electric currents are being delivered at 20,000 A or more. The screened conductors connecting the alternator to the step-up transformer in such power plants have to be of large dimensions and reliable. Construction principles of these conductors are explained. Due to the thermal wall created at around 20,000 A, cooling of each individual phase-screened conductor becomes essential. The forced-cooling technique employing air circulating in a closed circuit is found to be suitable. The recently conducted full-scale tests to evaluate the overall thermal performance, together with the dielectric integrity of screened coaxial conductors with forced cooling, are described. The future test program is outlined. (INIS)

20471 HEAT REMOVAL BY WET-TYPE COOLING TOWERS. Roegener, H. (Technische Univ., Hanover). (1973). vp. (In German).

From international congress: environment 72; Stuttgart, Germany (30 Jun 1972).

The report describes the thermodynamics of wet-type cooling towers and a throttle calorimeter for measuring the air moisture. (GE)

20472 WORLD ENERGY STRATEGIES: FACTS, ISSUES, AND OPTIONS. Lovins, A. B. London; Earth Resources Research Ltd. (1973). 51p.

After a review of the condition and prospects of man's very large and unevenly distributed energy conversion, the outlook for both conventional and unconventional fossil fuels is surveyed. Possible rates and side effects of production, institutional problems, and the general trend towards fuels of increasing technical simplicity are stressed. Coal emerges in a critical role as the main bridge to sustainable energy economies. Nuclear fission is then analyzed in detail. It is argued that fission technology is so complex and demanding that it should be abandoned. Adequate alternatives are known. The status, prospects, and possible problems of other energy technologies (nuclear fusion, geothermal power, tidal power, hydroelectricity, indirect and direct solar collection, etc.) are then assessed and promising avenues identified; likewise energy conversion, storage, and distribution technologies. Decentralized methods, and the special needs of non-industrial countries seeking appropriate development paths, are specially noted. Technologies that rely on energy income rather than on energy capital are adequate to meet all reasonable future needs of mankind. The foregoing considerations are combined with an assessment of certain ethical issues related to distribution, competition, climatic constraints, and future risks (e.g., in strategic-material safeguards, LNG transport, Arctic oil-spills, and radiation biology) to yield general conclusions. (auth)

20473 BEST SUBSTITUTE FOR PETROL MAY BE PETROL. Valery, N. New Sci.; 61: No. 882, 203-205(24 Jan 1974).

The calorific values of the fuels being studied were compared. Petrol is the most efficient, followed by methane in the form of LGN, then methanol and liquid hydrogen. Hydrogen is attractive only on a weight basis, but the storage problems are serious for its liquefied state. Liquid methane requires the same costly storage equipment as hydrogen, making it prohibitive for road vehicles. Methanol is a clean burning fuel and manufacturing processes are being developed. Tests are being sponsored by the Office of Coal Research and the American Gas Association and large-scale commercial plants could be capable of being on-stream by 1978. Synthetic crude oil has been manufactured in Sasol, South Africa since 1955. The technique is based on the Fischer–Tropsch process for synthesizing oil from coal, not only making synthetic petrol from coal but also the full range of products normally derived from crude oil. (MCW)

20474 THERMAL RISE OF GASES FROM POWER STATION CHIMNEYS. Rikhter, L. A.; Volkov, E. P.; Kormilitsyn, V. I. (Moscow Power Inst.). Therm. Eng. (USSR) (Engl. Transl.); 20: No. 2, 70-75(Feb 1973).

Translated from Teploenergetika; 20: No. 2, 52-57(1973).

A theoretical investigation was made of the thermal rise of the plume from a thermal power station chimney under the action of buoyancy, i.e. the difference in density between the flue gases and the ambient. The rise of a hot plume with zero excess impulse velocity in a turbulent flow was used as a physical model. Effective height and economic factors are indicated in the calculation; the plume rise is proportional to the capacity of the heat source and with a given capacity it is independent of stack diameter and of the velocity of the exit gases and their temperature. The thermal rise of the gases increases with fall in the intensity of atmospheric turbulence and is dependent on wind velocity. (MCW)

20475 SOME CONSIDERATIONS ON THE FLOW-RATE/PRESSURE CURVE OF THE STEAM WELLS OF LARDERELLO. Rumi, O. (Politecnico, Milan). Geothermics; 1: No. 1, 13-24 (Mar 1972).

The flow-rate/pressure relation for the wells of the Larderello area is considered. After an examination of experimental results recorded for many years, and after the discussion of the experimental flow-rate/pressure curve, an attempt is made to find the theoretic link between pressure and flow rate at the mouth of the borehole. The results of the experimental and theoretical approach are then compared, and a best fit curve is proposed. Moreover, the flow-rate/well bottom pressure curve as the true characteristic of the whole system of flow is suggested. (auth)

20476 MICROEARTHQUAKES: PROSPECTING TOOL AND POSSIBLE HAZARD IN THE DEVELOPMENT OF GEOTHERMAL RESOURCES. Ward, P. L. (Lamont-Doherty Geological Observatory, Palisades, NY). Geothermics; 1: No. 1, 3-12 (Mar 1972).

Microearthquakes have been observed near many major geothermal areas around the world. Where detailed data are available, there is a close spatial relationship between microearthquakes and geothermal activity. Earthquakes with magnitudes greater than about 4.5, however, are rarely observed in geothermal areas. Locations of microearthquakes can be used to locate active faults that may channel hot water toward the surface. Earthquakes provide some risk in the development of geothermal regions since during an earthquake the flow of thermal fluid can be enhanced or slowed and structures can be damaged. Modification of reservoir fluid pressure may influence the earthquake activity. (auth)

20477 RESISTIVITY STUDIES ON THE IMPERIAL VALLEY GEOTHERMAL AREA, CALIFORNIA. Meidav, T. (Univ. of California, Riverside); Furgerson, R. Geothermics; 1: No. 2, 47-62(Jun 1972).

Electrical resistivity was employed for mapping the Imperial Valley of California as part of a multi-disciplinary approach to assess its geothermal potential. Vertical and lateral resistivity changes were determined from Schlumberger depth soundings with effective probing depths up to 8000 ft. Known geothermal anomalies appear as residual resistivity lows superimposed on the regional gradient that decreases northwestward from the southeast corner of the Imperial Valley, near the Colorado River, to values about two orders of magnitude lower at the Salton Sea. A regional salinity gradient in the Imperial Valley trends northwest from a very low salinity at the Colorado River near Yuma, Arizona, to a very high salinity at the Salton Sea geothermal field. Abrupt changes in salinity exist across the Imperial fault, with salinities being much higher west of the fault. Maximum salinities can be estimated by combining the ground resistivity survey and formation factor-depth relationships compiled from well logs. From a technical point of view, the apparent-resistivity and longitudinal-resistivity maps are nearly identical at a probing depth of 3000 ft. Hence continuous profiling at a Schlumberger AB/2 spacing of 3000 ft should permit an effective, low-cost reconnaissance method for still-unsurveyed areas of the Imperial Valley. (auth)

20478 THERMAL PROBLEMS IN THE SITING OF REINJECTION WELLS. Bodvarsson, G. (Oregon State Univ., Corvallis). Geothermics; 1: No. 2, 63-6(Jun 1972).

A theoretical discussion is presented of the thermal problems involved in the disposal of flash water from geothermal power plants by reinjection. The basic equations for the subsurface temperature field in the reinjection zone are derived both for rocks with intergranular and fracture flow. The extent of the thermal contamination by the reinjected water is discussed. In the case of a continuous mass flow of flash water of 1000 kg/sec for a period of 25 years, the contamination may reach out to as much as 5 km or more from the point of re-entry, depending on the type of rock involved. (auth)

20479 EXERGY OF THERMAL WATER. Bodvarsson, G.; Eggers, D. E. (Oregon State Univ., Corvallis). Geothermics; 1: No. 3, 93-95(Sep 1972).

The exergy of a substance is the theoretical amount of mechanical work that can be derived from its heat content at given initial and end conditions. At given end conditions, the exergy is a state variable. The exergy per unit mass of pure water has been tabulated for the most important initial and end temperatures. An example showing the exergy flux in geothermal power plants is given. (auth)

20480 CEMENTING MATERIALS FOR GEOTHERMAL WELLS. Radenti, G.; Ghiringhelli, L. (AGIP Direzione Mineraria, San Donato Milanese, Italy). Geothermics; 1: No. 3, 119-123(Sep 1972).

In a well used in the search for endogenous fluids the opportunity exists to stop level of thermal waters of high temperature and pressure so that deeper levels can be reached, where it is inferred that there are fluids with better thermodynamic characteristics. The AGIP Laboratories have carried out tests on mortars assumed to be suitable for the clogging of the bedrocks containing the undesired waters. (auth)

20481 PHYSICAL MODEL OF PLANETARY MAGMATISM. Kadik, A. A.; Yaroshevskii, A. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geothermics; 1: No. 3, 124-131(Sep 1972).

The convective instability of magma liquids under physical conditions of the gravitational and geothermal fields of the Earth leads to radial transfer of heat and mass in the magma body. This transfer causes crystallization at the bottom and loss of volatiles at the top. As a result the magmatic mass rises towards the Earth's surface by a process similar to zone melting. A physico-chemical theory was developed in which the origin of melt, its rising, and its chemical differentiation are closely related processes. Formed by a partial or complete melting of primary deep material the magma interacts with the country rocks by melting and assimilation. Its composition changes according to the zone melting conditions and the magma floats upward. The extent of the process and the depth at which the movement degenerates depend on the quantity of heat in the magmatic system during its formation. (auth)

20482 EFFICIENCY OF NUCLEAR POWER STATIONS FOR DISTRICT HEATING. Arsen'ev, Yu. D.; Voronkov, M. E.; Sinev, N. M. At. Energ. (USSR); 35: No. 3, 197-198(Sep 1973). (In Russian).

The efficiency of a system for the supply of thermal and electrical power to the city of Moscow was mathematically analyzed on the basis of two variants. In the first, the thermal and electrical power was supplied by a nuclear electrical power plant and an organically fueled condensation electric plant. In the second, the power was supplied by a nuclear electrical power plant, a condensation electrical power plant, and a district heating nuclear power plant. The analysis showed that replacement of thermal and electric power plants with condensation power plants and district heating nuclear power plants does not result in over-expenditure of organic fuel. (JSR)

20483 DETERMINATION OF REGIONS OF USING HEAT AND POWER STATIONS OPERATING ON FOSSIL FUEL AND ON NUCLEAR FUEL ACCORDING TO LEVELS, COMPOSITION, AND RATE OF GROWTH OF HEAT LOADS. Khrilev, L. S.; Shadrina, A. P. (Siberian Power Inst., Novosibirsk, USSR). Therm. Eng. (USSR) (Engl. Transl.); 20: 16-21(Feb 1973).

Translated from Teploenergetika; 20: No. 2, 13-18(1973).

Employment of nuclear energy for supplying towns and industrial areas with heat can be met by constructing nuclear heat and power stations; nuclear heat only plants; by installing district heating units at nuclear condensing power stations situated near towns; or by supplying heat from nuclear condensing power stations by way of the products of condensing turbines or through a desuperheater. An economic evaluation of the nuclear heat and power stations concept is made. Calculations were made with water-moderated water-cooled reactors covering domestic heat demands and with water-graphite reactors with nuclear steam superheat covering both domestic heat demands and process heat demands. Results show that nuclear heat and power stations are found to be more effective than heat and power stations operating on fossil fuel at a heat load of about 1500 Gcal/h or more. (MCW)

20484 DISTRICT HEATING TURBINE FOR NUCLEAR HEAT AND POWER STATIONS. Bunin, V. S.; Vasil'ev, M. K. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 2, 22-26(Feb 1973).

Translated from Teploenergetika; 20: No. 2, 18-21(1973).

An investigation was made to select the design of a new turbine to operate at main steam conditions of 60 kgf/cm^2 and 275 C. Comparisons have shown that the water-moderated water-cooled reactors are desirable to operate with the district heating turbines for performance and efficiency. The annual characteristics of the T-150/250-60 turbine plant with connected heat load of 1500 Gcal/h at different heating factors of 1.0, 0.7, 0.5, and 0.4 were calculated. The characteristics of a nuclear heat and power station with one turbine are also determined. (MCW)

20485 CORROSION OF METALS IN GEOTHERMAL POWER PLANTS. Tskhvirashvili, D. (Inst. of Energy, Tbilisi, USSR); Vardigoreli, O.; Acolsin, P. Geothermics; 1: No. 3, 113-118(Sep 1972).

Experimental research is reported on corrosion of metals and alloys in waters of various springs that differ in temperature and output as well as chemical composition. Tests were carried out on natural thermal waters both at the head of boreholes and in the laboratories. For the first time a dependence was established between the corrosion rate of metals and the velocity of thermal water, the pH value, the temperature, the concentration of atmospheric oxygen in the thermal water, "Waiting time," i.e. the period of time that must elapse before corrosion begins in heating systems by geothermal fluids, was determined. A method of reducing corrosion in this type of heating is that of creating a vacuum in the thermal waters accompanied by their treatment with corrosion inhibitors. Corrosion of carbon steel due to thermal waters containing H_2S and CO_2 can now be prevented in a cheap and reliable way. (auth)

20486 COMPOSITION OF DISTILLATES OBTAINED BY DELAYED COKING OF HIGHER FRACTIONS OF SHALE OIL. II. Composition of Paraffins–Olefins in Fraction 150 to 250°C. Purre, T.; Orav, A.; Rang, S.; Eisen, O.; Khallik, E. (Inst. of Chemistry, Tallin, USSR). Izv. Akad. Nauk Est. SSR, Khim. Geol.; 22: No. 4, 296-300(1973). (In Russian).

The composition of paraffins and olefins in 150 to 250°C distillate fractions was investigated on a capillary column (80 m × 0.25 mm) coated with polyethylene glycol 4000. n-Alkenes, amounting to 50 per cent of the total C_5 to C_{15} normal hydrocarbons, are mostly represented by 1-alkenes (50 to 60%) and 2-alkenes (20 to 30%). Due to a higher content of n-alkenes, the distillate appears as a chemical intermediate superior to the distillates of batch coking. (auth)

20487 COMPOSITION OF THE LOW-BOILING FRACTIONS OF DICTYONEMA SHALE OIL. Ivanov, A.; Rang, S.; Eisen, O.; Styopin, S. (Inst. of Chemistry, Tallin, USSR). Izv. Akad. Nauk Est. SSR, Khim. Geol.; 22: No. 4, 301-305(1973). (In Russian).

The individual composition of dictyonema shale oil (the Toolse deposit) tar fractions boiling at up to 78° and 78 to 120° C, as well as of gas naphtha, was investigated by capillary and reaction gas chromatography. Eighty components were identified in gas naphtha, 25 components in the fraction boiling at up to 78°, and 38 components in the fraction boiling at 80 to 120°. The main components were stated to be benzene and toluene. (tr-auth)

Information Handling

Refer also to abstract 20529.

20488 (TID-26500) SUBJECT CATEGORIES USED IN NUCLEAR SCIENCE ABSTRACTS, 1967–1973. Whitson, M. O. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jan 1974. 15p. Dep. NTIS $4.00.

A complete listing of subject categories and their corresponding tag numbers for Nuclear Science Abstracts during the years 1967 through 1973 is presented in tabular form. (MOW)

20489 DATA ACQUISITION SYSTEM (ADVANCE ULTRASONICS SYSTEM) (3 JUL 1973) (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2374).

62 Drawings.

Law

Refer also to abstracts 18596, 18605, 20442, and 20503.

20490 (REG/G-8.9(9-73)) ACCEPTABLE CONCEPTS, MODELS, EQUATIONS, AND ASSUMPTIONS FOR A BIOASSAY PROGRAM. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Sep 1973. 2p. DRS.

20491 DOSE DETERMINATION AND PHYSICAL RADIATION PROTECTION MONITORING ACCORDING TO THE REGULATIONS OF THE NEW X-RAY ORDINANCE. Kossel, F. (Bundesgesundheitsamt, Berlin). Arbeitsschutz (Cologne); No. 4, 176-178(1973). (In German).

In the X-Ray Ordinance, the real equivalent dose to the body is frequently indicated as maximum permissible dose limit. For the determination of whether the protective measures are sufficient, local dose or dose rate measurements are made taking into account the switch-on time elapsed prior to the proper application and personnel dose monitoring is made during the period of application itself. In order to obtain a relation between the thus measured quantities and the dose limits given in the X-Ray Ordinance, the operator of the x-ray installation has to define the operating mode of the device in question. These statements and the operational behavior of the radiation protection devices have to be re-examined from time to time. (GE)

20492 URANIUM AND POLITICS. Wisdorff, E. Handelsblatt; 28: No. 232, 3(Dec 1973). (In German).

The type of uranium enrichment plant that will help Europe to guarantee the fuel supply for its nuclear power plants during the future decade, i.e., either the gas diffusion method of France, the USA and England, or the gas centrifuge method of Great Britain, Holland and Western Germany, as well as the political aspects and economic problems of competition and technology, is discussed. (GE)

20493 NEPA IN THE COURTS. A Legal Analysis of the National Environmental Policy Act. Anderson, F. R. Baltimore; Johns Hopkins University Press (1973). 338p. $6.95.

The National Environmental Policy Act of 1969 requires all federal agencies to give consideration to environmental effects in planning all programs. Specific action-forcing procedures had required agencies to file 3,635 statements by Dec. 31, 1972. The book considers the judicial interpretations of NEPA since it became law and chapters are included on: NEPA and Congress; How a NEPA Suit Reaches Court; The Requirement of Strict Compliance; Circumstances Requiring an Impact Statement; Problems of Transition: Projects and Programs in Progress when NEPA was Enacted; Preparation and Content of Impact Statement; NEPA and Federal Decision Making; and The Impact Statement in Perspective. Specific examples are cited in the Appendices. (MCW)

20494 LAW ON ALTERATION OF THE RADIATION PROTECTION LAW (1958:110). Sv. Forfattningssamling; No. 1004, vp. (21 Dec 1973). (In Swedish).

Radiological work must not be performed without permission from an authority appointed by the King, nor may anybody hold

x-ray equipment or other technical device aimed to emit ionizing radiation or trade with radioactive substances. Permission may be given to people with a certain profession or to certain institutions or companies. (SW)

20495 WHERE ARE WE? On War and Peace and NPT and Safeguards. Spinrad, B. I. (Oregon State Univ., Corvallis). Bull. At. Sci.; 30: No. 1, 34-38(Jan 1974).

Representatives from seventeen countries met in Tallberg, Sweden, June 1973 to discuss big issues of these times, but more specifically, the nuclear proliferation problems. The topics discussed were the spread of nuclear technology; military consequences of the spread of nuclear technology; new nuclear developments; safeguards; cooperation in peaceful uses of nuclear energy; security problems of non-nuclear weapon countries; and the forthcoming Non-Proliferation Treaty review conference in 1975. The views of the author are presented and serve as a warning to the communities. (MCW)

20496 UNITED STATES GEOTHERMAL LEGISLATION AND ENVIRONMENTAL IMPACT FOR LEASING. Geothermics; 1: No. 4, 146-163(Dec 1972).

The Geothermal Steam Act of Dec. 24, 1970 authorizes the Secretary of the Interior to make disposition of geothermal steam and associated geothermal resources and provides for leasing of public lands for geothermal resources and provides for leasing of public lands for geothermal resources exploration, development, and production. The act is printed in full and an edited draft compiled by the U. S. Department of the Interior of the Environmental Impact Statement for the Geothermal Leasing Program is published. (MCW)

Management

Refer also to abstract 20490.

20497 (LBL-2454) OCAW LOCAL PRESIDENTS RESPOND TO OCCUPATIONAL SAFETY AND HEALTH COMPLIANCE SURVEY. Collins, S. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 29 Oct 1973. Contract W-7405-eng-48. 10p. (CONF-731046-1). Dep. NTIS $3.00.

From national safety congress and exposition meeting; Chicago, Illinois, USA (29 Oct 1973).

Results are reported from a survey of the local presidents of US Oil, Chemical, and Atomic Workers Union of the extent to which employees of research and development organizations are complying with Federal occupational safety and health standards. (CH)

20498 (NP-19916) SEVENTEENTH ANNUAL REPORT, 1972-1973. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1973. 64p. Dep. NTIS (U. S. Sales Only) $5.25.

Activities of the Danish Atomic Energy Commission and the Risø Research Establishment for the period April 1, 1972 to March 31, 1973 are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, a selected list of staff publications is given, and the design data on research facilities are presented. (Denmark)

20499 (NP-19942) AB ATOMENERGI 1972. Statement by the Board and the Managing Director. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

A description is given of the company AB Atomenergi that is the central organization for research and development in the nuclear energy field in Sweden. The main task of the company is research and development to support the Swedish program on light water reactors. AB Atomenergi advises the government on nuclear matters. For the most part the company works on a contract basis for customers within Sweden as well as abroad. (Sweden)

20500 (ORNL-tr-2576) GENERAL ADMINISTRATIVE REGULATIONS FOR PLANTS SUBJECT TO LICENSING UNDER PARAGRAPH 16 OF THE TRADE REGULATIONS. Translated by R. G. Mansfield from Gemeinsames Ministerialbl., A; 15: No. 26, 433-448(1964). 24p. Dep. NTIS $3.25.

General administrative regulations on technical guidelines were issued by the Federal government and apply to such plants as lead, copper, and zinc processing plants; sintering and remelting plants; foundries; cement grinding and burning plants; burning of refuse; coal-fired boilers; and all kinds of furnaces. Examination must be made of licenses to erect a plant, for changing the place of operation, for change in operation of a plant, for supplemental regulations on requirements for the technical equipment and the operation of a plant, and for regulations on the kind and extent of smoke, soot, dust, gases, vapors, and odors issuing from the plant. (MCW)

20501 IAEA 1974: BUDGET PROBLEMS, TECHNICAL ASSISTANCE, SAFEGUARDS OPERATIONS. Rembser, J. (Bundesministerium fuer Forschung und Technologie, Bonn). Atomwirt. Atomtech.; 18: No. 12, 574-576(Dec 1973). (In German).

The main topics discussed at the 17th Annual Conference of the IAEA in Vienna were budget problems, arising from the latest price increases and from the decline of the dollar rate, which have a considerable effect also on the most important future tasks of the IAEA, namely technical assistance and safeguards operations. Another item on the agenda was the market study on the construction of nuclear power plants for and in developing countries. Following the extension of the Board of Governors, the German Federal Republic now has a permanent seat in this body as one of the nine most developed countries. (GE)

20502 COMMISSARIAT A L'ENERGIE ATOMIQUE AND THE FUTURE. Goure, F. (CEA, Paris). Notes Etud. Doc.; No. 3945, 5-50(1 Dec 1972). (In French).

The chapter titles of the present document are as follows: presentation of the 1945 ordinance; technological developments and evolution of the CEA in the principal sectors of activity between 1945 and 1970; facilities possessed by the CEA (infrastructure, personnel, budget); atomic energy in 1970 (situation overseas and in France); the decree of the 29th of September 1970; and reorganization of the CEA in 1971. (FR)

20503 PROPOSED CHANGES IN BASIS FOR COOPERATIVE ARRANGEMENT FOR THE LMFBR. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, First Session, February 28, and May 4, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 689p. GPO $4.35.

The basis of the original cooperative arrangement was approved by the Joint Committee after its submission by the AEC and three days of hearings in September, 1972. In January 1973, the AEC informed the committee that in the process of negotiating the definitive contracts for the arrangements, the parties had agreed on some changes that had not been foreseen. The changes were presented and involved such things as representation on specific committees by the participating organizations and responsibilities for certain products. The Project Management Corporation, Breeder Reactor Corporation, Tennessee Valley Authority, Commonwealth Edison Company, and the Atomic Energy Commission are the participating parties. (MCW)

Mathematics and Computers

Refer also to abstracts 18336, 20567, and 20571.

20504 (AECL-4593) PAL 8: A PROGRAM TO ASSEMBLE PROGRAMS FOR THE PDP-8 COMPUTER. Goulding, D. B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 85p. Dep. NTIS (U.S. Sales Only) $6.25. AECL $2.00.

PAL 8 is a program, written to run on a CDC 6600 computer, to assemble PAL III, PAL D and PAL 8 code for a PDP-8 computer. The program produces assembly listings with the necessary cross-reference tables and a binary object code paper tape. Included in this report are both a general description of the assembler and specific examples of its use at the CRNL Computing Centre. (auth)

20505 (BNWL-SA-4818) NUMERICAL MODEL OF THE GREAT PLAINS SQUALL LINE THUNDERSTORM. Hane, C. E. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Oct 1973. 10p. (CONF-731031-1). Dep. NTIS $3.00.

From eighth conference on severe local storms; Denver, Colorado, USA (15 Oct 1973).

20506 (COO-1469-236) QUARTERLY TECHNICAL PROGRESS REPORT, JULY-SEPTEMBER 1973. (Illinois Univ., Urbana (USA). Dept. of Computer Science). 1973. 135p. (UIUCDCS-QPR-73-3). Dep. NTIS $8.75.

Summaries are given for the following research topics: (1) circuits, (2) hardware systems, (3) software systems, (4) switching theory and logical design, (5) machine and software organization studies, (6) computer systems analysis, (7) aspects of combinatorial computing, (8) theory of digital computer arithmetic, (9) automation of introductory computer science courses, (10) center for advanced computation report summary, (11) machine perception and intelligence, (12) statistics, (13) computer languages for mathematical and numerical analysis, and (14) general department information. (MOW)

20507 (JAERI-M-5299) BASIC PLOT-ROUTINES FOR USC-3 SYSTEM. Subroutine PLO(X,Y,IPEN) and subroutine NUN(X,Y,S,

J,A). Kawarasaki, Y. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 24p. (In Japanese). NTIS (U. S. Sales Only).

Two basic plot subroutines, Subroutine PLO and Subroutine NUN, were prepared for the USC-3 system consisting of a Toshiba ICD-507 computer (16K words, 20 bits), digital plotter DPL-602, and other peripherals. Both the subroutines can be called with Fortran language from the main program. Subroutine PLO has the same functions as "Call Plot(X,Y,IPEN)", and Subroutine NUM is similar to "Call Number. The functions and performances of these two subroutines are described in both software and hardware. (auth)

20508 (JAERI-M-5305) GPICTUR-I: GRAPHICAL FIGURES INPUT AND OUTPUT PROGRAM BY GRAPHIC DISPLAY. Nakamura, Y.; Onuma, Y. (Japan Atomic Energy Research Inst., Tokyo). Jun 1973. 18p. (In Japanese). NTIS (U. S. Sales Only).

The graphical program GPICTUR-I, which enables drawing any graphical figures on a cathode-ray tube (CRT) by lightpen, was developed for the FACOM 230-35 ROS. By this program, graphical figures drawn on the CRT can be read by the computer and written on a magnetic tape. Moreover, when the tape is read, the graphical figures stored on the tape are redisplayed on the CRT and can be modified by a user. The operation is all controlled by lightpen buttons displayed on the CRT. (auth)

20509 (KFK-1866) DISPATCHER PRIMITIVES FOR SYMMETRIC MULTIPROCESSOR SYSTEMS. Nehmer, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Sep 1973. 108p. (In German). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis. Submitted to Univ., Karlsruhe, Ger.

A universal set of dispatcher primitives is described on the basis of a layer structure for operating systems. Some implementation alternatives are compared by simulation, giving special attention to the problem of processor conflicts. (16 figures, 45 references) (tr-auth)

20510 (KFK-PDV-6) INTERACTIVE DIALOG SYSTEM. Werthmann, R.; Kazis, E. (Gesellschaft fuer Kernforschung m.b.H.; Karlsruhe (F. R. Germany)). Jul 1973. 107p. (In German). Dep. NTIS (U. S. Sales Only) $7.50.

A dialog system (IDIAL, Interactive Dialog System) to interface data processing with its environment is described. The initial description covers several tasks and the main demands that such a dialog system must fulfill. The various interface points are then presented and described. The interface point between man and dialog systems will be especially in-depth. Relatedly, the proposed dialog language for IDIAL will be explained. Several evaluations for the implementation of the system are presented. (tr-auth)

20511 (LBL-2319) COMPUTERIZED PRODUCTION OF A DATA COMPILATION: A TABLE OF ISOTOPES. Lederer, C. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 13p. (CONF-731121-1). Dep. NTIS $3.00.

From STC-TID seminar on continuing education in communication; Berkeley, California, USA (17 Nov 1973).

20512 (RT/EDP-(73)5) CDP: INTERACTIVE GRAPHIC SIMULATION FOR THE DYNAMIC ANALYSIS OF CONTINUOUS SYSTEMS. Work Manual. Ricci, A.; Teolis, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 Sep 1973. 17p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.00.

An IBM 2250 graphic system for the interactive simulation of continuous systems is illustrated. Time-dependent quantities can be plotted or an animated, real or schematic, representation of the system being studied can be given. (tr-auth)

20513 (SLL-73-225) TWO COMPUTER PROGRAMS FOR THE SENSITIVITY ANALYSIS OF HIGHER-ORDER FILTERS. Soderstrand, M. A.; Lathrop, J. F. (Sandia Labs., Livermore, Calif. (USA)). Jan 1974. Contract AT(29-1)-789. 125p. Dep. NTIS $8.25.

A typical filter exhibits a transfer function in the frequency domain which is, as a function of the complex frequency variable (Laplace variable) s, a numerator polynomial (the zeros of which are called zeros) divided by a denominator polynomial (the zeros of which are called poles). Changes in network elements (e.g., the values of resistors, capacitors, inductors, and amplifier gains) cause changes in the coefficients of these transfer function polynomials. The two computer programs described in this report can be used to determine the relationship between these changes and the changes they introduce in the position of the poles and zeros. The poles of the networks are usually more important than the zeros and are grouped together into complex conjugate pairs which are defined by their resonant frequency ω_0 and quality factor Q. The specific problem solved by the computer programs outlined here is that of finding the relationship between changes in ω_0 and Q and changes in the coefficients of the transfer function denominator. The first program described is a FORTRAN IV program called CASAHOF (Computer Aided Sensitivity Analysis of Higher Order Filters), written for the GP250 interactive graphics console at Sandia Laboratories, Livermore. The other program described is a REDUCE II program which finds the algebraic relationships between the ω_0 and Q changes (sensitivities) and the coefficient changes (sensitivities). (auth)

20514 (UCRL-51454) USER'S MANUAL FOR TRILIN: A COMPUTER CODE TO CALCULATE TRANSIENT RESPONSE IN LINEAR SYSTEMS. Hallquist, J. O.; Murray, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Oct 1973. Contract W-7405-eng-48. 33p. Dep. NTIS $4.00.

TRILIN is a system of computer codes used to analyze the response of linearly elastic, three-dimensional framed structures subjected to arbitrary forcing functions, impulsive loadings, and seismic input. The codes are described briefly; input to each code is detailed. Two examples are presented, showing the response of a simple I-beam and of a rectangular three-dimensional frame structure to various inputs. (auth)

Miscellaneous

20515 (COO-3153-114) ELASTIC AND PLASTIC DEFORMATION OF SOLIDS. Annual Progress Report, February 1, 1973-January 31, 1974. Ruoff, A. L. (Cornell Univ., Ithaca, N. Y. (USA). Dept. of Materials Science and Engineering). 22 Oct 1973. Contract AT(11-1)-3153. 9p. Dep. NTIS $3.00.

The 0°C freezing point of mercury determination based on the combined length and ultrasonic time pressure gage was completed and published. The transformation pressure obtained is $P_T = 7571.2 \pm 1.6$ bars. The maximum deviation of the manganin gage from linearity is -11.6 ± 0.1 bars at $P_{T/2}$. A method of machining meter-long LiF single crystals was developed, and combined length and ultrasonic measurements on such a crystal are underway to determine second-pressure derivatives of elastic moduli and to determine the pressure dependence of the Gruneisen parameter. An apparatus was built to measure the pressure dependence of the yield stress of metals with small yield stress and experiments will commence shortly on potassium at liquid nitrogen temperatures. A pressure vessel was equipped with a furnace for internal heating to high temperature and experiments are underway to carry out hot isostatic compaction of very fine carbide particles under controlled conditions to obtain sintering to theoretical density with little grain growth. (auth)

20516 (MHSMP-73-43-I) DIVIDING WALL STUDIES. Period Covered: July-September 1973. Crutchmer, J. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1973. 5p. Dep. NTIS $3.00.

Six small-scale shots involving foamed concrete and Ethafoam wall treatments were fired and analyzed. One shot involving normal density concrete slabs as wall treatment and one using a 6-inch thick wall with no treatment were fired and analyzed. These were fired for comparison with standard-size (3-inch thick) treated walls. As expected, the 6-inch thick wall yielded results comparable to treated-wall tests. (auth)

20517 (ORNL-tr-2775) EFFECT OF TEMPERATURE ON NITROGEN ABSORPTION FROM THE MEDIUM BY CHLORELLA PYRENOIDOSA. Mikryakova, T. F.; Trukhin, N. V. Translated by M. Gerrard from Biol. Vnutr. Vod, Inform. Byull.; No. 5, 12-14(1970). 2p. Dep. NTIS $3.00.

Results indicate that a decrease in temperature (but not below threshold values) causes a decrease in nitrogen absorption by algae, and an increase in temperature causes a marked decrease. (LMT)

20518 (RT/FI-(73)29) PAL-MOGILNER-ZOLOTUKHIN-BELL-BABALA DISTRIBUTION. Pacilio, N.; Jorio, V. M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 4 Sep 1973. 96p. (In Italian). Dep. NTIS (U. S. Sales Only) $7.00.

Important recent investigations by Routti, Szeless and Ruby allow a vast and systematic study to be performed on the nature of the Pal-Mogilner-Zolotukhin-Bell-Babala (PMZBB) profile. The calculation of the n-th order derivative of a composite function and, in particular, the probability distribution profile from the PMZBB generating function is treated. An extensive set of numerical results is given in a specifically detailed form. (auth)

20519 (SLA-73-1052) PHOTOINSTRUMENTATION TECHNOLOGY, A TWO-YEAR PROGRAM. Bates, O. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 29p. Dep. NTIS $3.50.

The Photoinstrumentation Technology Program trains technicians in creative design and implementation of high-speed and

other scientific photographic recordings. The specific instructional objectives and the program curriculum are presented. (auth)

Chemistry

20520 (ARH-2905) DISCUSSION OF GLASS–WATER INTERACTIONS. Physical and Chemical Processes. Diebold, F. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 15 Sep 1973. Contract AT(45-1)-2130. 43p. Dep. NTIS $4.25.

Leaching data for the alkali and alkaline earth silicate glasses are reviewed. The mechanism is based on the structure being dominated by SiO_4 tetrahedra forming a random network by sharing their corners (bridging oxygens). Dealkalization of the glass is initiated by the proton adsorption on to the glass surface. The intermediate to long-term interaction is characterized by a steady state between dealkalization and lattice attack such that the leached zone maintains a constant thickness. (DLC)

20521 (CNEA-352) 9-10 HYDROXYBORAZARO PHENANTHRENE. Alternative Methods of Preparation and Purification. Videla, G. J.; Molinari, M. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 9p. (In Spanish). Dep. NTIS (U.S. Sales Only) $3.00.

Two alternatives of the usual method of preparation, which make it simpler and give a product of higher purity and yield, are presented. The first one is a modification of Dewar's method, performing in a single operation the introduction of B in position 9 in the o-amino diphenyl and the ring formation, by means of a Friedel–Krafts reaction with aluminum chloride and potassium fluoborate. The second one is a reaction between o-amino diphenyl and boric acid, in the presence of a dehydrating agent. A method of purification by crystallization from aqueous solutions is described. It gives a product of high purity, as shown by analysis, spectrometry and determination of crystal structure. (auth)

20522 (CNEA-354) STUDY OF THE REACTION BETWEEN ISOCYANATES AND ORGANIC ACIDS USING COMPOUNDS LABELLED WITH ^{14}C. de Troparevsky, M. L. P.; Troparevsky, A.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

The reaction between phenyl isocyanate and organic acids in equimolar ratio was studied in toluene solution. The main derivatives formed using acetic acid, stearic acid, and trichloroacetic acid are identified. The distribution of the C from the isocyanate group and from the carboxyl group in the final reaction products, could be established by using phenyl isocyanate and acetic acid labelled with ^{14}C in the isocyanate group and the carboxyl group, respectively. Mechanisms regarding the formation of the CO_2 evolved are indicated. (auth)

20523 (INP-845) ROTATIONAL JUMPS OF NH_3 GROUPS IN $[Ni(NH_3)_6]X_2$ CRYSTALS. Janik, J. M.; Migdal–Mikuli, A.; Janik, J. A. (Institute of Nuclear Physics, Krakow (Poland)). Jul 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The ir band contour method was used to determine the rotational correlation times and the barriers to rotation for NH_3 groups in $[Ni(NH_3)_6]X_2$ crystals, where X = Cl, Br, or I. (DLC)

20524 (INP-846) PROTON JUMPS IN CRYSTALLINE HYDRONIUM PERCHLORATE. Janik, J. M.; Rachwalska, M.; Janik, J. A. (Institute of Nuclear Physics, Krakow (Poland)). Jul 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Specific heat and quasi-elastic neutron scattering were measured to determine the thermodynamic parameters of the 248°K phase transition of $H_3O \cdot ClO_4$. Proton jumps with an average time of 2.7×10^{-12} s are postulated in phase I above 248°K. (DLC)

20525 (IS-T-626) ANALYTICAL APPLICATIONS OF INDUCTIVELY COUPLED PLASMA-OPTICAL EMISSION SPECTROSCOPY. Kniseley, R. N. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 89p. Dep. NTIS $6.50.

Thesis.

The applicability of an inductively coupled plasma-optical emission spectroscopic system to practical analytical problems is demonstrated using metallurgical samples (steels) and biological samples (whole blood and serum) as typical examples. The evaluation is based on the ability of this excitation source to accurately determine trace and ultratrace concentrations of metallic elements in the presence of high concentrations of matrix materials which often are of variable composition. The results of the studies on whole blood and serum suggest that the inductively coupled plasma system is capable of directly determining trace elements at the $\mu g/ml$ level in biological fluids with essentially no sample preparation. Analytical data are presented for Al, Co, Cr, Cu, Mn, Ni, P, Pb, and Zn since all of these elements are of biological importance and some of them represent the most difficult elements to determine because of their low concentrations in biological fluids. A technique is also described for the analysis of biological fluids by the direct nebulization of sample volumes as low as 25 microliters. The problems involved in the analysis of metallurgical samples are explored and the ability of the inductively coupled plasma excitation source to solve many of these problems is demonstrated. The analytical results for common alloying elements in steel as compared with NBS standards show that the analyses are accurate. The ability of the inductively coupled plasma system to directly determine the rare earth and refractory elements in steel demonstrates the capabilities of this system in difficult analytical problems. The detection limits observed for various elements in the presence of an Fe matrix are essentially the same as those reported for these elements in a dilute water solution, demonstrating that the presence of a matrix material does not adversely affect the analytical capabilities of this system. (auth)

20526 (SLA-73-5984) FUTURE OPPORTUNITIES FOR THE CHEMIST IN THE WEST AND PROBLEMS OF THE TRANSITION PERIOD: ACADEMIC TO INDUSTRIAL. McDonald, J. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 24p. (CONF-731124-1). Dep. NTIS $3.25.

From operation interface meeting of the American Chemical Society; D. H. Lawrence Ranch, New Mexico, USA (1 Nov 1973).

Opportunities in the western U. S. which will open up for materials chemists in energy R&D (particularly coal gasification) are described. (DLC)

20527 (SLA-74-6009) STUDIES OF THE PHOTOELECTROCHEMICAL REACTIONS OF A TiO_2 SEMICONDUCTOR BY THE ROTATING RING-DISK ELECTRODE METHOD. Fujishima, A.; Honda, K. Translated from Seisan Kenkyu; 22: 478-481(1970). 16p. Dep. NTIS $3.00.

It was found that Br^- was oxidized on a TiO_2 electrode surface subjected to irradiation by light of energy >3.0 eV, i.e. at a wavelength <415 μ. Since Br^- oxidation occurred on the TiO_2 surface at −0.5 V, it appeared that Br^- also underwent photosensitized electrolytic oxidation. (auth)

20528 (TID-26527) KINETIC, MAGNETIC, AND MOESSBAUER STUDIES ON PORPHYRIN SYSTEMS. Progress Report. Hambright, P. (Howard Univ., Washington, D. C. (USA). Dept. of Chemistry). 15 Jan 1974. Contract AT(40-1)-4047. 12p. Dep. NTIS $3.00.

20529 BODY FLUIDS ANALYSES DATA ACQUISITION SYSTEMS (Aug 1973) (Engineering Materials). (Oak Ridge National Lab., Tenn. (USA)). (CAPE-2376).

20 drawings.

Three miniaturized, computer-based data acquisition and analyses systems, developed and installed for on-line, real-time analysis of the chemical constituents of urine and other body fluids, are presented. The computer systems, which are identical, are equipped with 12K words of memory, a dual cassette tape transport, a real-time clock, a digital input/output interface, an automatic program loader, and an analog input subsystem. These interfaces permit the computer to be connected simultaneously to two chromatographic analyzers for data collection and processing. (WHK)

20530 SUCCESS, SUCCESSION, AND ADAM SMITH. Woodwell, G. M. (Brookhaven National Lab., Upton, NY). Bioscience; 24: No. 2, 81-87(Feb 1974).

It is the belief of the author that the dependence of man on nature is, more than the crisis of energy and more than the developing crisis of world economics, the emergent scientific and political issue of the next year. It is always taught that the pressures on the environment are the result of population increase. An additional pressure is human activities. World supplies of energy are finite. The challenge is to recognize the dependence of man on the Earth's biota and to bend phenomenal scientific and technological resources to see that the biota is preserved and enhanced in the most energetic way. It is a challenge to redirect growth to such that 7 billion people in about 30 years survive successfully. (MCW)

Life Sciences

20531 (AECL-4507) RECORD LINKAGE OF HOSPITAL ADMISSION-SEPARATION RECORDS. Smith, M. E. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1973. 58p. Dep. NTIS (U. S. Sales Only) $5.00. AECL $1.50.

A co-operative pilot study involving the design of a complete system for the linkage of hospital admission-separation records into longitudinal health histories is described. (CH)

20532 (COO-3275-1) STUDIES ON BIOLUMINESCENCE AND ENERGY TRANSFER MECHANISMS. Final Report.

McElroy, W. D. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Biology). 1 Dec 1973. Contract AT(11-1)-3275. 25p. Dep. NTIS $3.25.

An organic mechanism for firefly bioluminescence is proposed based on chemical and enzymatic reactions of luciferin, luciferase, ATP, CO_2, and Mg or Mn ions leading to light emission. (CH)

20533 (EUR-5005) ENVIRONMENT AND LIFE QUALITY: STUDY OF SOURCES AND VOLUMES OF RESIDUES AND SOLID, LIQUID, AND GASEOUS WASTES OF HEAVY METAL REJECTS IN AMBIENT MEDIA IN THE GERMAN FEDERAL REPUBLIC AND IN FRANCE. (Commission of the European Communities, Luxembourg). May 1973. 75p. (In French). Dep. NTIS (U. S. Sales Only) $5.75. EUR FB.50,-.

Estimates are presented of the volumes of mercury, cadmium, and chromium and their derivatives involved in their processes of their production, treatment, and consumption. Also estimated are the toxic quantities released to the environment. The aggregate picture is displayed by means of three tables. (tr-auth)

20534 (EUR-5014) ENVIRONMENT AND LIFE QUALITY: PRELIMINARY STUDY ON THE STRUGGLE AGAINST POLLUTION IN THE RHINE BASIN. Anne, P. (Commission of the European Communities, Luxembourg). Sep 1973. 142p. (In French). Dep. NTIS (U. S. Sales Only) $9.25. EUR FB.150,-.

The problem is discussed under three chapters, namely: (1) origin and effects of the pollution, (2) actions undertaken at the national and international levels, and (3) examination of possible actions and a recommendation in the struggle against the pollution. (13 tables, 9 figures, 40 references) (LMT)

20535 (TID-26526) IN VITRO BIOSYNTHESIS OF PLANT PROTEINS AND NUCLEIC ACIDS. Progress Reports, 1966–1968 and Final Report, April 15, 1965–July 31, 1969. (Maryland Univ., College Park (USA)). [nd]. Contract AT(30-1)-3536. 54p. Dep. NTIS $4.75.

Results are reported from studies on the cell-free biosynthesis of nucleic acids and proteins by preparations from corn seedlings. A list of publications that report the results obtained in detail is included. (CH)

Materials

20536 (CEA-R-4525) THEORETICAL AND EXPERIMENTAL STUDY OF ATOMIC DIFFUSION IN MAGNESIUM. Combronde, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). Feb 1974. 114p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

Thesis. Submitted to Paris Univ., Orsay (France).

The self-diffusion and heterodiffusion constants of Ag, Cd, In, Sn, and Sb were measured for monocrystalline magnesium. Experimental data show a valency effect on the activation energy parallel to the c axis. In addition, measurements of the effect of hydrostatic pressure on the heterodiffusion of Cd show that weak relaxation occurs around a vacancy in Mg. Le Claire's model is unable to explain heterodiffusion data whatever perturbating potentials are chosen. An elastic and electrostatic calculation of the energy of migration of the solute atom is proposed. The results explain the behavior of most closed-packed normal metals. (auth)

20537 (CONF-731104-13) ^{61}Ni MOESSBAUER STUDIES OF SUBSTITUTED Ni SPINELS. Love, J. C.; Obenshain, F. E. (Florida Inst. of Tech., Melbourne (USA); Oak Ridge National Lab., Tenn. (USA)). 1973. 5p. Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

^{61}Ni nuclear gamma resonance (NGR) spectra were measured at 4.2°K for the mixed spinels $NiFe_xCr_{2-x}O_4$ ($0 \leq x \leq 2$), and magnetic hyperfine fields $|H_{A,B}(x)|$ were derived for tetrahedral (A) and octahedral (B) sites. The B-site fields lie in the range (~20 to 94) kOe, quite comparable with values obtained for many octahedrally coordinated Ni compounds. For $x < 1$, Ni ions partially occupy A-sites and the hf fields for these ions are anomalously large, varying from 440 kOe for $x = 0$ to ~630 kOe for $x = 0.5$. This later field value, which is also found for the related compound $NiFe_{0.5}V_{1.5}O_4$, is the largest yet reported for ^{61}Ni. It is suggested that the composition dependence of the A-site field is due to large orbital contributions and supports an interpretation of Goodenough that spin-orbit interactions dominate Jahn-Teller interaction at A-site Ni^{2+} for the range $\sim 0.2 \leq x < 1.0$. (auth)

20538 (COO-1009-10) EFFECT OF SHORT-RANGE ORDER ON MECHANICAL PROPERTIES OF ALLOYS. Final Report. Nicholson, M. E. (Minnesota Univ., Minneapolis (USA)). 25 Jan 1974. Contract AT(11-1)-1009. 8p. Dep. NTIS $3.00.

The anomalous electrical-resistivity behavior of Ag–Pd and Au–Pd alloys upon cold working and annealing was studied. It was suggested that the anomalous behavior could be explained on the basis that cold working destroyed short-range order (S. R. O.). X-ray studies of Au–Pd alloys confirmed the existence of S. R. O. in these alloys. Further x-ray studies confirmed that S. R. O. was destroyed in a manner to explain the anomalous resistivity behavior. The work also included a study of the influence of S. R. O. on the strength and plastic behavior of Au–Pd alloys. It was shown that the yield drop behavior and overshooting in these alloys was due to S. R. O. The yield drop was less than would have been predicted from the theory of Fisher. A new theory using dynamic dislocation theory was advanced. The Bauschinger effect in single alloy crystals exhibiting S. R. O. was much less than in pure metals when deformed on a single set of planes. (auth)

20539 (COO-2166-13) STUDY OF THE ROLE OF IMPURITIES AND ADDITIVES ON CERAMIC DENSIFICATION. Johnson, W. C. (Michigan Technological Univ., Houghton (USA)). 1973. 111p. Dep. NTIS $7.75.

Thesis.

Minor amounts of certain elements were found to aid in densification of sintered Al_2O_3 (MgO, NiO, and Y_2O_3 additives) and hot-pressed MgO (LiF and NaF additives). (DLC)

20540 (INR-1467) MOESSBAUER EFFECT ON ^{125}Te IN SEMICONDUCTOR COMPOUNDS OF $Hg^{125}Te$ AND $Cd^{125}Te$. Bielecki, M.; Suwalski, J.; Dabrowski, L. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

20541 (IS-T-624) LOW TEMPERATURE HEAT CAPACITY OF RUBIDIUM–TUNGSTEN BRONZE. Kienzle, W. E. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 123p. Dep. NTIS $8.25.

Thesis.

The heat capacity of Rb_xWO_3 ($0.27 \leq x \leq 0.33$) prepared by two techniques, electrolysis and solid-state reaction, was measured from 1 to 14°K and from 1 to 11°K, respectively. The single sample grown by the solid-state reaction exhibited a superconducting transition temperature (T_c) in zero magnetic field of 2.7°K. An applied magnetic field of 5 kG suppressed T_c below 1°K. For temperatures below 4°K the heat capacity in the normal state can be expressed as $C = (2.38\ mJ/mole\text{-}K^2)T + (0.28\ mJ/mole\text{-}K^4)T^3$. An "excess" heat capacity, present above 4°K, can be explained in terms of a single Einstein mode associated with the vibration of the rubidium ion in the hexagonal channels. From the Einstein temperature of 59°K it was possible to calculate a force constant of 8.5 (10^3) dyne/cm for this mode. The electrolytically grown samples (EGS) were Type-I superconductors with a T_c of 1.8°K that was independent of x-value for $0.27 \leq x \leq 0.33$. An applied magnetic field of 100 gauss was sufficient to suppress T_c below 1°K. The heat capacity of the EGS increased with increasing x-value and showed the presence of an Einstein mode above 4°K. (auth)

20542 (ITF-73-115-E) TWO-EXCITON STATES IN LAYER-TYPE ANTIFERRODIELECTRICS. Gaididei, Yu. B.; Loktev, V. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The conditions for appearance of the bound states in an exciton–exciton interaction and the width of the two-exciton band for arbitrary directions of the total wave vector are analyzed. The bound-state splitting obtained has no analogue in the one-particle energy spectrum. (auth)

20543 (JINR-P4-7513) BELOV COLOR GROUPS AND THE MAGNETIC STRUCTURE CLASSIFICATION. Koptsik, V. A.; Kotsev, I. N.; Kuzhukeev, Zh. N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A system is suggested for classification of the stationary magnetic structures of crystals on the basis of the Belov (polychromatic) space groups; by the examples it is shown the advantage of the suggested system in comparison with the classifications on the basis of the Fedorov and Shubnikov symmetry groups. (auth)

20544 (JINR-P4-7514) METHODS OF COLOR SYMMETRY AND THE THEORY OF REPRESENTATION GROUPS IN MAGNETIC CRYSTAL PHYSICS. I. The Magnetic Interpretation of the Belov (Polychromatic) Space Groups. Koptsik, V. A.; Kotsev, I. N.; Kuzhukeev, Zh. N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The magnetic interpretation of the Belov (polychromatic) space groups is presented, which allows one to give more complete description of the symmetry of the stationary magnetic structures in crystals. (auth)

20545 (KFK-1875) INVESTIGATION OF COLLECTIVE ATOMIC MOTIONS IN LIQUID GALLIUM BY INELASTIC NEUTRON SCATTERING. Loeffler, U. (Kernforschungszentrum

Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Nov 1973. 50p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

The inelastic coherent scattering of slow neutrons from liquid gallium was measured at 305 and 1253°K. The experiments were performed with the rotating-crystal time-of-flight spectrometer at the cold source of the reactor FR2. With an incident neutron energy of 5.2 meV for elastic scattering an energy resolution of 0.3 meV was achieved. The scattering law $S[Q,\omega]$ determined from the experimental data is compared with several models. The collective excitations are discussed in terms of a dispersion relation $\omega_m[Q]$ and a Q-dependent relaxation time $\tau[Q]$. Both functions were deduced by fitting model parameters to the quasi-elastic scattering [de Gennes narrowing]. Attempts were also made to derive $\omega_m[Q]$ directly from the measured $S[Q,\omega]$ by determining the fourth moment. Special emphasis has been put on the study of the temperature dependence of the quasi-elastic scattering for Q values around the first maximum of the static structure factor. The results are discussed in view of a model proposed by Schneider et al., relating the first minimum of $\Delta\omega[Q]$ with the liquid–solid phase transition. (auth)

20546 (KFK-EXT-6-73-2) NEWSLETTER '73 IN STEREOLOGY. Ondracek, G. (ed.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Sep 1973. 181p. (In German and English). Dep. NTIS (U. S. Sales Only) $11.25.

The report consists of several articles in respect to stereology as for example about European instruments for quantitative image analysis or news about image analyzers and computers. It also deals with a review about events in the field of stereology such as the past symposium on quantitative stereometric metallography in the CSSR as well as forthcoming conferences. Scientific information is given on this stereometric characterization of microstructure and its effects on the properties of materials. The way how to characterize this microstructure by the determination of the stereometric factors of the microstructural constituents is described. Such factors are the shape factor and the orientation factor as well as the distribution of dispersed phases in multiphase materials or the grain- and particle-size distributions in metallic materials. (tr-auth)

20547 (KFK-EXT-6-73-5) INFLUENCE OF NITROGEN ON THE CREEP-RUPTURE BEHAVIOR OF AN UNSTABILIZED AUSTENITIC 18/14 CrNi-STEEL. Schirra, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). 9 Oct 1973. 36p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The effects of nitrogen (0.04 and 0.14%) on the tensile and creep-rupture properties of an unstabilized 18/14 CrNi steel at temperatures up to 800°C were investigated. The results show that a nitrogen content of 0.14% slightly increases the yield and ultimate tensile strength, decreases the total elongation, and does not change the uniform elongation compared with the values of the steel with 0.04% N_2. The rupture time is also increased by the higher N_2 content, while the creep ductility remains nearly unchanged. (auth)

20548 (LBL-2510) MECHANISM OF PRESSURE WELDING. Mohamed, H.A.E.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 58p. Dep. NTIS $5.00.

Thesis.

The mechanism in polycrystalline aluminum, copper, silver, and gold was investigated. (19 figures) (DLC)

20549 (NP-19948) STUDY OF THE DEPENDENCE ON HIGH PRESSURE OF THE KONDO EFFECT IN THE DILUTE ALLOY Cu(Fe). Lipham, J. G. (North Carolina Univ., Chapel Hill (USA). Dept. of Physics). 1972. 149p.

Thesis.

20550 (ORNL-tr-2752) STRESS-RUPTURE OF WELD METAL IN THE WELD SEAMS OF LOW-ALLOY TEMPERATURE-STABILIZED STEELS. Sobotka, J.; Prnka, T. Translated by Robert H. Kernchan From Arch. Eisenhuettenw.; 43: No. 5, 427-429(1972). 5p. Dep. NTIS $3.00.

By fusing, with an arc weld, material consisting of a low-alloy temperature-stabilized steel with 2.25% Cr, 1% Mo and the other with 0.5% Cr, 0.5% Mo, and 0.25% V, a weld seam was formed whose strength properties at room temperature were the equivalent of the rolled or forged initial material. The stress-rupture properties for both materials were, however, up to 20% below the average ISO-recommended values. The conjecture arises that the phenomenon can be traced back to the 0.1% lower carbon content of the weld metal, in which the amount and distribution of the precipitated carbides is of decisive influence. The carbides appearing in the weld metal were investigated by means of x rays, and the chemical compositions of the isolated residues were determined. (tr-auth)

20551 (ORNL-tr-2753) EFFECT OF THE STABILIZATION RATIO ON THE CREEP AND PRECIPITATION BEHAVIOR OF AUSTENITIC HIGH-TEMPERATURE-STRENGTH STEEL WITH ABOUT 16 PERCENT Cr, 13 TO 16 PERCENT Ni, 2 PERCENT Mo, AND ADDITION OF NIOBIUM. Ruttman, W.; Gerlach, H.; Kautz, H. R. Translated by E. G. Silver from Arch. Eisenhuettenw.; 38: No. 4, 301-307(Apr 1967). 27p. Dep. NTIS $3.50.

Annealing and creep rupture tests of up to 30,000 hours at 650°C were carried out on three melts each of the steels X8CrNiMoNb1613 with about 0.04 to 0.08% C, 0.03 to 0.05% N, 17% Cr, 2% Mo, 0.4 to 0.9% (Nb + Ta), and 12% Ni, and on X8CrNiMoNb1616 with about 0.05 to 0.09% C, 0.03 to 0.1% N, 16.5% Cr, 2% Mo, 0.45% (Nb + Ta), and 16% Ni. Metallographic and radiographic examinations of the annealing and creep rupture test pieces were conducted to reveal the creep and precipitation behavior. Notch bend tests on long-time annealed test pieces were also conducted. (auth)

20552 (ORNL-tr-2756) EFFECT OF HIGH ELONGATION RATES ON THE DEVELOPMENT OF THE YIELD POINT IN FERRITIC STEELS IN THE LOW-TEMPERATURE REGION. Schmidtmann, E.; Russell, D. Translated by E. G. Silver from Arch. Eisenhuettenw.; 43: No. 10, 781-788(Oct 1972). 32p. Dep. NTIS $3.75.

Results of examination are reported on the course of the stress–time curve in the tensile shock test with elongation rates of 8.4×10^{-4} to 2.5×10^{2} s^{-1} and testing temperatures of +20 to –196°C, as carried out on steels showing yield points ranging from 150 to 1300 newtons/mm^2. Relations of the grain size and yield point in static loading with the dependence of the yield point effects on temperature and elongation rate in dynamic loading were studied. The results were checked by calculation with the aid of the Hall–Pelch relation. The test results obtained on plain and notched specimens were compared. (auth)

20553 (ORO-3401-18) EFFECTS OF SURFACE COATINGS ON THE PLASTIC DEFORMATION OF METAL SINGLE CRYSTALS. Final Report, 15 May 1965–30 November 1972. Block, R. J. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 22 Oct 1973. Contract AT(40-1)-3401. 56p. Dep. NTIS $5.00.

The rupture of anodically formed coatings on 2024-T4 aluminum undergoing corrosion fatigue was monitored using electrode potential techniques. The influence upon the fatigue life of films formed at high and low current densities was gaged by the period required for the initiation of cracks in the coating as well as the total numbers of cycles to failure. An improvement in fatigue life was noted in specimens anodized in a slightly acidic electrolyte which produced strongly compressive coatings. However, the period between crack initiation and failure was longest with coatings formed in basic electrolytes. These coatings had much lower residual compressive stresses. (auth)

20554 (SGAE-2174) LAMINAR BOUNDARY LAYERS, THE ANALOGY RELATIONS BETWEEN HEAT TRANSFER AND MASS TRANSFER AND THEIR APPLICABILITY TO LIQUID METAL CORROSION. Schwarz, N. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Reaktortechnik). Sep 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A literature survey of the formulas of the laminar hydraulic sublayer in laminar and turbulent flow conditions is presented. The heat and mass transfer analogy is discussed and restrictions with respect to liquid-metal corrosion are summarized. By interpreting experimental results it can be shown that the thickness of the laminar sublayer should be responsible for some effects of mass transfer phenomena. Nevertheless, because of insufficient knowledge of relevant physical properties, it is impossible to deduce analogy relations that describe the measured weight losses quantitatively. (auth)

20555 (SLA-73-897) DEVELOPMENT OF A HIGH STRAIN RATE CONSTITUTIVE EQUATION FOR 6061-T6 ALUMINUM. Herrmann, W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 47p. Dep. NTIS $4.50.

A relatively simple viscoplastic constitutive equation is constructed from previously published experimental data for 6061-T6 aluminum. Equilibrium strain-hardening behavior is described by a multi-element model, which includes a Bauschinger effect, fitted to static uniaxial stress data. Elastic moduli and their dependence on strain and internal energy are determined by a Mie-Grueneisen equation of state evaluated from ultrasonic data and high-pressure shock-wave data. The relaxation function is evaluated from compressive steady-wave data. The constitutive equation is used to obtain numerical flow field solutions of plate

impact experiments which are compared with existing experimental unloading wave data. (auth)

20556 (SLA-74-6008) PHOTOSENSITIZED ELECTROLYTIC OXIDATION AT A TiO_2 SEMICONDUCTOR ELECTRODE. Fujishima, A.; Honda, K.; Kukuchi, S. Translated from Kogyo Kagaku Zasshi; 72: 108-113(1969). 25p. Dep. NTIS $3.25.

Measurements were carried out on polarization behavior with TiO_2 (rutile), an n-type semiconductor, as an electrode. In the absence of irradiation, hydrogen evolution took place under cathodic polarization, and there was a pronounced electrolytic rectification phenomenon accompanied by a very low current under anodic polarization. Irradiation of the surface of the TiO_2 electrode with light had no effect on the cathodic current, but greatly increased the anodic current. This current flow was produced only by irradiation with light of wavelength 415 mμ or less (corresponding to the TiO_2 band-gap 3.0 eV), and was proportional to the intensity of the light. The rise potential was measured as −0.5 eV (vs. standard calomel electrode (SCE) at pH 4.7). The electrolytic reaction was confirmed to be evolution of oxygen due to electrolysis of water, and not dissolution of the electrode itself as has been reported for n-type semiconductors. This oxygen evolution, occurring at potentials about 1 V lower than the equilibrium potential, is called "photosensitized electrolytic oxidation", and occurs as a result of absorption of the light energy by the semiconductor. It was also confirmed that the oxidation of I^- to I_2 took place at potentials lower than the equilibrium potential. The mechanism is discussed with the aid of a band model for semiconductors. (auth)

20557 (TID-26525) EFFECT OF CHANGING ALLOY COMPOSITION ON HYDROGENATION REACTIONS. Final Report. Cadenhead, D. A. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Dec 1973. Contract AT(11-1)-3706. 11p. Dep. NTIS $3.00.

Studies of chemical reactivity and surface composition have been carried out on a series of reduced-oxide copper-nickel alloys. The results show that the chemical reactivity of these alloys, while dependent on the exact nature of the process, has little or no correlation with the bulk composition. Reactivity is, however, clearly a function of the surface composition which was determined through hydrogen chemisorption titrations. The surface composition approximated closely to that predicted from thermodynamic considerations, remaining constant over a wide bulk compositional range. The situation is not unlike that found for copper-nickel evaporated metal films, however precise observations on the granular material can be complicated by both surface impurities and porosity. The possibility of controlling surface composition, and hence reactivity, of reduced oxide alloy catalysts (either supported or non-supported) has been demonstrated. (auth)

20558 (UCRL-13429) ULTRASONIC WELDING OF METALS IN VACUUM. Final Report. Frisch, J.; Chang, U. (California Univ., Berkeley (USA). Coll. of Engineering). Aug 1969. 116p. Dep. NTIS $8.00.

An experimental and theoretical investigation of the mechanism of ultrasonic welding between specimen pairs of 3/4-inch spherical and flat surfaces is described. Materials used in this study were OFHC copper, 2024-T351 aluminum, and 17-4 pH stainless steel. The results of tests conducted in ultrahigh vacuum at 10^{-7} to 10^{-10} torr pressures were compared with those performed under ambient atmospheric conditions. The test configurations for all experiments were similar, inasmuch as the specimens with the spherical surface were mounted on the tip of an ultrasonic horn and brought into contact with the flat specimens. Under application of normal compressive loads in the range of 1 to 5 lbs. and a simultaneous pulse of 20 kHz of 0.2 to 1.0 seconds duration, bonding was accomplished. Subsequently, a tensile load opposite to the compressive normal load was applied to the welded specimens in order to break the bond, thereby establishing the coefficient of adhesion and breaking strength. (auth)

20559 (UCRL-51477) ULTRASONIC TRAVEL TIMES IN A GRANODIORITE UNDER UNIAXIAL COMPRESSION. Benzing, W. M.; Bonner, B. P.; Schock, R. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Nov 1973. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

Samples of dry granodiorite were deformed to failure in compression at constant confining pressures while the principal strains and the travel times of compressional (t_p) and shear (t_s) ultrasonic pulses were measured along the principal stress axes. Uniform axial stresses (σ_1) were achieved by applying a fluid pressure to the ends of a cylindrical sample. At low principal stress values ($\sigma_1, \sigma_3 < 100$ MPa), the compressional-wave travel time in the direction of maximum compressive stress is found to decrease independent of σ_3. This suggests that the primary influence is the closing of elongate cracks whose major axes lie normal or nearly normal to the propagation direction. The t_p and t_s data at low stresses show no measurable Δt in the direction normal to σ_1, indicating that cracks oriented parallel or nearly parallel to σ_1 are uninfluenced by low levels of σ_1. At high stresses when microfracturing occurs, t_p and t_s increase for both orientations, the magnitude of the change increasing with increasing σ_1. However, total Δt's prior to failure are much larger when measured normal to σ_1. Furthermore, the t_s change normal to σ_1 is much more sensitive to the σ_1 stress level than the change in t_p. (auth)

20560 (UCRL-75339) CRITICAL ENERGY FOR SHOCK INITIATION OF FUZE TRAIN EXPLOSIVES. Walker, F. E.; Wasley, R. J.; Green, L. G.; Nidick, E. J. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1973. 16p. Dep. NTIS $3.00.

Results of shock initiation experiments conducted for tetryl and A-5 are presented, along with some data on the shock initiation of other explosives. The experiments were conducted using a gun system. An equation which has been useful in correlating these shock data is given. Some applications of the critical energy concept (represented by the above equation), to explosive train designs for NASA space systems are included. The concept's usefulness to DOD ordnance agencies now replacing tetryl in fuze trains with A-5 is also indicated. (auth)

20561 RAW MATERIALS: U.S. GROWS MORE VULNERABLE TO THIRD WORLD CARTELS. Wade, N. Science; 183: No. 4121, 185-186(18 Jan 1974).

The success of the Arab oil embargo may be encouraging producers of other scarce raw materials to form a cartel against the United States. Pessimistic and optimistic opinions abound. Most third world countries need to sell as much as they can. The political hues of most potential members of a cartel make an arrangement unlikely, such as in the case where Southern Rhodesia, South Africa, Turkey, and the USSR corner the exportable market of chromium, but a coalition is unlikely. The U. S. government has a powerful weapon against cartels in the form of a massive, $6 billion stockpile of strategic minerals. The nonenergy mineral position of the USA seems certain to weaken in the long haul. Technological advances, recycling, substitution, and changing lifestyles to pay for deferred social costs of past consumption and inequities in distribution seem to be in order. (MCW)

Physics

20562 (AEC-tr-7517) HYDRAZINE IN BOILER WATER. Kuhn, E. Translated From Acqua Ind.; 8: No. 41, 6-12(1966). 14p. Dep. NTIS $3.00.

The advantages of hydrazine for water treatment and corrosion prevention in boilers are discussed. (DLC)

20563 (ANL/ES-27) TRANSPORTATION NOISE: IMPACTS AND ANALYSIS TECHNIQUES. Nelson, K. E.; Wolsko, T. D. (Argonne National Lab., Ill. (USA)). Oct 1973. Contract W-31-109-eng-38. 121p. Dep. NTIS $8.25.

Computerized models that can be used by transportation engineers, planners, and environmentalists to assess the impacts of transportation noise problems generated by highway and airport facilities are presented. The characteristics of transportation noise are discussed in terms of generation, effects and impacts, measurement, and control. The economic, physiological, psychological, and societal effects of urban noise are described in detail. (MCW)

20564 (COO-2058-4) MOLECULAR STRUCTURE STUDIES: A GAS-PHASE ELECTRON DIFFRACTION UNIT EMPLOYING COUNTING TECHNIQUES. Final Technical Report, June 1, 1969–August 31, 1972. Thompson, H. B.; Jacob, E. J. (Toledo Univ., Ohio (USA)). 1972. Contract AT(11-1)-2058. 23p. Dep. NTIS $3.25.

Construction of an electron-diffraction apparatus of unique design, employing electron-counting techniques, was undertaken. The apparatus is to be competitive with photographic diffraction units in terms of sample required, and it is hoped that it will be superior in versatility and in freedom from a number of sources of uncertainty. During the contract period the instrument chamber, vacuum system, counting electronics and logic, electron optics, and detection system were designed. Construction was completed on all but the detection system and final details of a mechanical drive. Work on this apparatus is to continue under sponsorship by the National Science Foundation. (auth)

20565 (ITF-73-150-P) NEW METHODS IN SPECTRAL RESEARCH OF LIQUIDS AND SOLIDS. Davydov, A. S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The methods are for measurement of lifetimes of electronic and vibrational excitations, using laser pulses. (DLC)

20566 (JINR-P12-7442) SEARCH FOR THE REGULARITIES IN THE CHANGE OF PHYSICAL-CHEMICAL PROPERTIES OF THE ELEMENTS: HOMOLOGS AND THEIR COMPOUNDS. III. Ionization Potentials of Halogen Compounds. Kolachkovski, A.; Norseev, Yu. V.; Nefedov, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Linear dependence of the ionization potentials of some organic and inorganic halogen compounds on their universal parameters is observed. A general equation, reflecting this regularity, is found. (auth)

20567 (KFK-PDV-8) AUTOMATIC FAILURE DIAGNOSIS IN TECHNICAL PROCESSES. Literature Summary. Siebert, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). Aug 1973. 27p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

The literature summary is intended to be a base for further investigations in the field of failure diagnosis (detection and localization of faults) in technical processes, considering the use of process computers. A general view of methods for process supervision, i.e., the detection of faults and the resulting steps to avoid damages, was made. All bibliographical data available to July 1973 were compiled. (68 references) (tr-auth)

20568 (LGI-72-12-E) USE OF A CHANNELPLATE IN LABORATORY EXPERIMENTS. A Review of Available Data. The Choice of the Channelplate Working Regime and Channelplate Electro-Geometrical Parameters. Rager, J. P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Gas Ionizzati). Nov 1972. 55p. Dep. NTIS (U. S. Sales Only) $4.75.

A tentative to ordering various data regarding the performance of multichannel-plate electron multipliers (MCP) mountings is presented: the gain vs voltage characteristics; the efficiency with respect to the primary radiation (electrons or photons); and the effect of ageing due to the accumulated counting. The effect of special conditioning such as baking is also reviewed. Tentative conclusions are given upon the mechanisms causing irreversible gain degradation in MCP. Indications are provided as to the best way of choosing the MCP working regime and MCP pitch depending upon the class of applications in which the multiplier is committed. The interest of developing small-pitch MCP in order to postpone the appearance of the saturation effects on pulsed operation is outlined. (auth)

20569 (RISO-M-1654) FORMALISATION OF FAILURE MODE ANALYSIS OF CONTROL SYSTEMS. Taylor, J. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1973. 67p. (R-9-73). Dep. NTIS (U. S. Sales Only) $5.50.

Failure-mode-analysis techniques using graphic aids to evaluate failure conditions and events have been developed over several years. A mathematical description of conditions and events is presented, and it is related to a mathematical model of a system. A systematic method for deducing event sequences is developed, and the method is applied to practical examples. The main reason for formalization of failure analysis is to provide a concept of completeness or thoroughness for a failure analysis. At the same time, the possibilities for automation of failure analysis are considered. (auth)

20570 (RISO-M-1666) OCCURRENCES OF STABILITY CLASSES, WIND SPEEDS, AND WIND DIRECTIONS AS OBSERVED AT RISOE. Jensen, N. O. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1973. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

The meteorological data subject to analysis were measured at Risø during the years 1958 through 1967. The data are grouped in 12 wind direction sectors, 7 stability categories, and 5 wind-speed intervals. The number of observations in each group is given in tabular form. Some results are expressed also by means of wind roses. (auth)

20571 (SLA-73-189) BIBLIOGRAPHY OF AERODYNAMICS COMPUTER PROGRAMS. Curry, W. H. (comp.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1973. 142p. Dep. NTIS $9.25.

A compilation of computer programs used in aerodynamics-related work at Sandia Laboratories is presented. Subject areas include aerodynamic coefficients and load prediction, data reduction, flow-field calculations, heat transfer and ablation, and trajectory and vehicle motions. Each program entry lists the originator, reference document, descriptive material, and personal contacts at Sandia Laboratories. This compilation of programs supersedes that prepared by P. J. Roache and published as SC-TM-68-837, November 1968. (auth)

20572 (SLA-73-714) SONIC BOOM STUDIES ON AREA III SLED TESTS. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 110p. Dep. NTIS $7.50.

Supersonic sled tests on the Sandia 1524-m (5000-ft) track generate sonic booms of sufficient intensity to allow some airblast measurements at distance scales not obtained from wind tunnel or flight tests. During acceleration, an emitted curved boom wave propagates to a caustic, or focus. Detailed measurements around these caustics may help to clarify the overpressure magnification which can occur from real aircraft operations. Six fixed pressure gages have been operated to document the general noise field, and a mobile array of twelve gages—obtained through NASA support—has been used to record in the vicinity of caustics. Conclusions are presented from results of fifteen tests assembled to date that have been partially analyzed. (35 tables, 85 figures, 32 references) (auth)

20573 (SLA-73-896) THERMAL BATTERY CELL TESTING: APPARATUS AND RESULTS. Bush, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 22p. Dep. NTIS $3.25.

A number of variables such as temperature and pressure influence the discharge of thermal batteries. A single cell tester has been developed to eliminate some of these variables so that those remaining could be studied more effectively. In addition to describing the tester, the cell testing procedure is reviewed and some recent test results are presented. (auth)

20574 (SLA-73-1006) GAS FLOW MODELING OF VARIABLE AREA FLOWMETERS (ROTAMETERS). Webster, H. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 19p. Dep. NTIS $3.00.

A method of modeling small variable area flowmeters (rotameters) has been developed and tested. The results indicate that the calibration of a meter with one gas allows prediction of its calibration for another gas with an uncertainty that typically does not exceed 5%. (auth)

20575 (SLA-73-5997) GROUND-ECHO CHARACTERISTICS FOR A GROUND-TARGET PULSE-DOPPLER RADAR FUZE OF HIGH DUTY RATIO. Williams, C. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). 21 Nov 1973. 17p. (CONF-731131-1). Dep. NTIS $3.00.

From Tri-service electronic fuse symposium; Washington, District of Columbia, USA (26 Nov 1973).

A pulse-Doppler radar fuze for use against ground targets at high burst heights can operate at low peak power provided a high duty ratio is used. The high duty ratio brings about ambiguous ground return that is prevented from firing the fuze by randomly coding the phase of the transmitted pulses. This causes the ambiguous return to appear as random noise. This paper provides formulas for the calculation of the clutter-noise power density and of the signal power so that the performance of the radar can be determined. The paper also discusses the myth of "decorrelation" that is alleged to destroy the transmitted-phase modulation in the echo and so make it useless. (auth)

20576 (SLL-73-295) OPTIMIZATION OF A LIFTING PARACHUTE SYSTEM FOR LAYDOWN DELIVERY OF A BOMB. Rychnovsky, R. E.; Everett, R. N. (Sandia Labs., Livermore, Calif. (USA)). Jan 1974. Contract AT(29-1)-789. 36p. Dep. NTIS $4.00.

An analytic investigation has been performed to study the merits of incorporating a lifting parachute into a 2400 lb bomb delivery system. Lift to drag ratios of 0.3 for the initial ribbon parachute are sufficient to lift the bomb and allow enough time for a second parachute to slow the system to its terminal velocity. Impact velocities of less than 60 ft/s and impact angles greater than 50° appear achievable for a release velocity range from Mach 0.53 to 1.2. Substantial improvements over alternate parachute systems appear feasible. (auth)

20577 (UCID-16423) DEGENERATE CUBIC NONLINEAR SUSCEPTIBILITY TENSOR IN AN ISOTROPIC MEDIUM AND ITS DETERMINATION. She, C. Y.; Moran, M. J.; Carman, R. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Nov 1973. Contract W-7405-eng-48. 30p. Dep. NTIS $3.50.

Accurate measurements of the full cubic nonlinear tensor χ are discussed. Preliminary experimental data demonstrating feasibility are described. A brief comprehensive account is given of the theory of the degenerate or near-degenerate cubic susceptibility of an isotropic medium, such as glass. While the detailed knowledge of the frequency dependence of the cubic susceptibility tensor may be more of academic interest, it is believed that the values of all the independent tensor elements at the relevant laser frequency are needed in order to explore directly the relative importance of various mechanisms at 100 psec to 1 nsec, as well as the consequence of nonlinear refractive index effects on the high-power beam propagation in the laser medium, windows, lenses, and iso-

lators. In addition, the effect of light-by-light scattering on high-power beam propagation is also briefly discussed. (auth)

20578 (Y-1924) LIGHTING FOR HIGH-ACCURACY MACHINING AND INSPECTION. Ochiltree, C. W.; Adams, J. T. (Oak Ridge Y-12 Plant, Tenn. (USA)). 2 Feb 1974. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

Requirements for very-high-accuracy machining and inspection operations demand close temperature control of machines and work pieces. In order that these temperatures may be controlled to ±0.05°F, it was necessary to restrict the amount of heat energy which could radiate from the area lighting fixtures. Field tests have demonstrated that a combination of supply and exhaust air ducts connected to the air conditioning system plus housings fitted with a dual lens system to filter the infrared radiation, reduced by 90%, the amount of heat energy transmitted by the lighting system with only about an 18% reduction in the illumination level. (auth)

20579 HARDWARE DEVELOPED FOR INSPECTION OF HEMISPHERICAL PARTS (JAN 1973) (ENGINEERING MATERIALS). (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). (CAPE-2378).
2 Drawings.

20580 GENERAL CHEMISTRY CALORIMETER MODELS 12 APR 1968) (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2379).
23 Drawings.

20581 NEUTRAL BEAM, ACCEL VOLTAGE REGULATOR CONTROL AMPLIFIER (4 DEC 1972) (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2377).
5 Drawings.

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Announcing the publication of

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Alexander Sesonske
Purdue University

Published by
Technical Information Center,
Office of Information Services,
U. S. Atomic Energy Commission

November 1973

495 pages, 151 illustrations, 6 by 9 inches
Library of Congress Catalog Card
Number 73-600245

Available as TID-26241 for $10.60 from
National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22151

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Electric Utility Economics
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Fuel-System Analysis
Design Considerations
Some Optimization Approaches
Index

Nuclear Power Plant Design Analysis provides background in two basic areas: (1) design of nuclear power plants with emphasis on the reactor system and (2) design analysis, the systematic consideration of important individual parameters that affect the design in an interrelated way. It is a text for design-oriented courses for nuclear engineering students who have already had an introduction to the field but require additional perspective of interacting engineering areas important to reactor design. Emphasis is given to such areas as engineering economics, thermal-hydraulics, safety analysis, and fuel systems, which in an introductory course are often not covered with sufficient breadth to enable a student to participate in a meaningful group-design effort. The book is also intended for the practicing engineer interested in improving his background in reactor design.

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